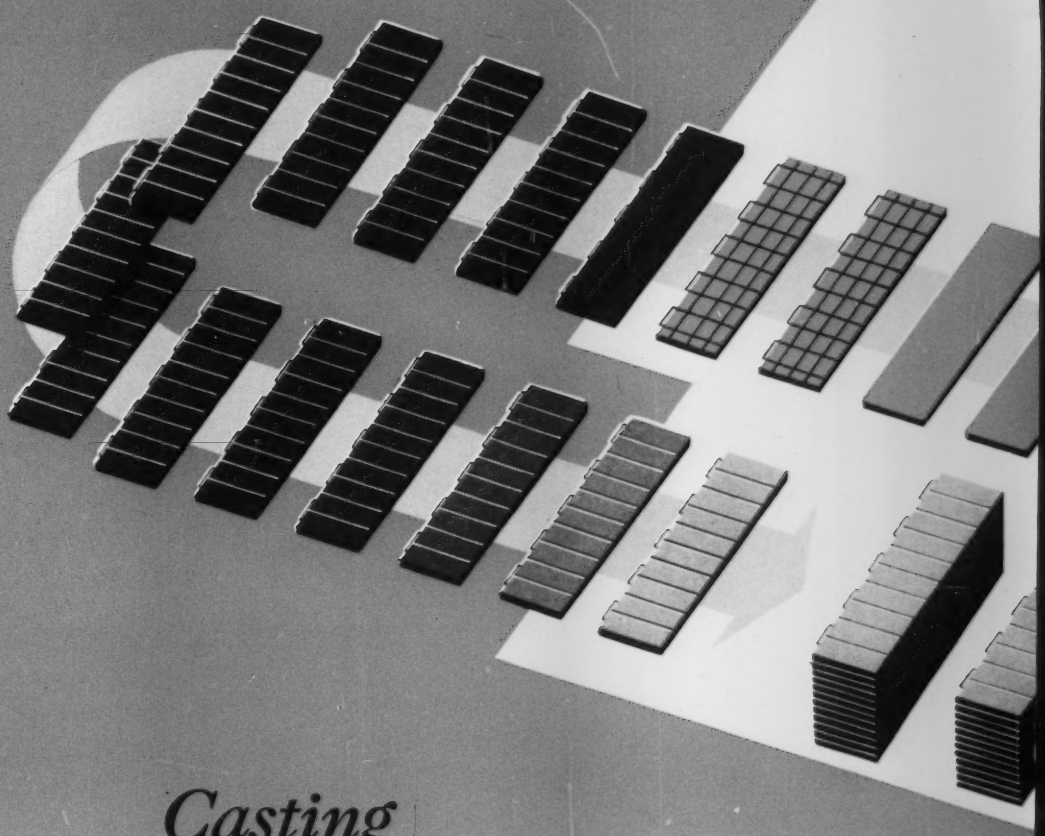
# AUTOMATION

OCTOBER 1959



# *Casting Concrete Mats*

THE MAGAZINE OF AUTOMATIC MANUFACTURING OPERATIONS

- Integrating Product and Process
- Assembling Complex Devices
- Continuous pH Control of Process Solutions
- Automatic Gage Control of Metal Rolling

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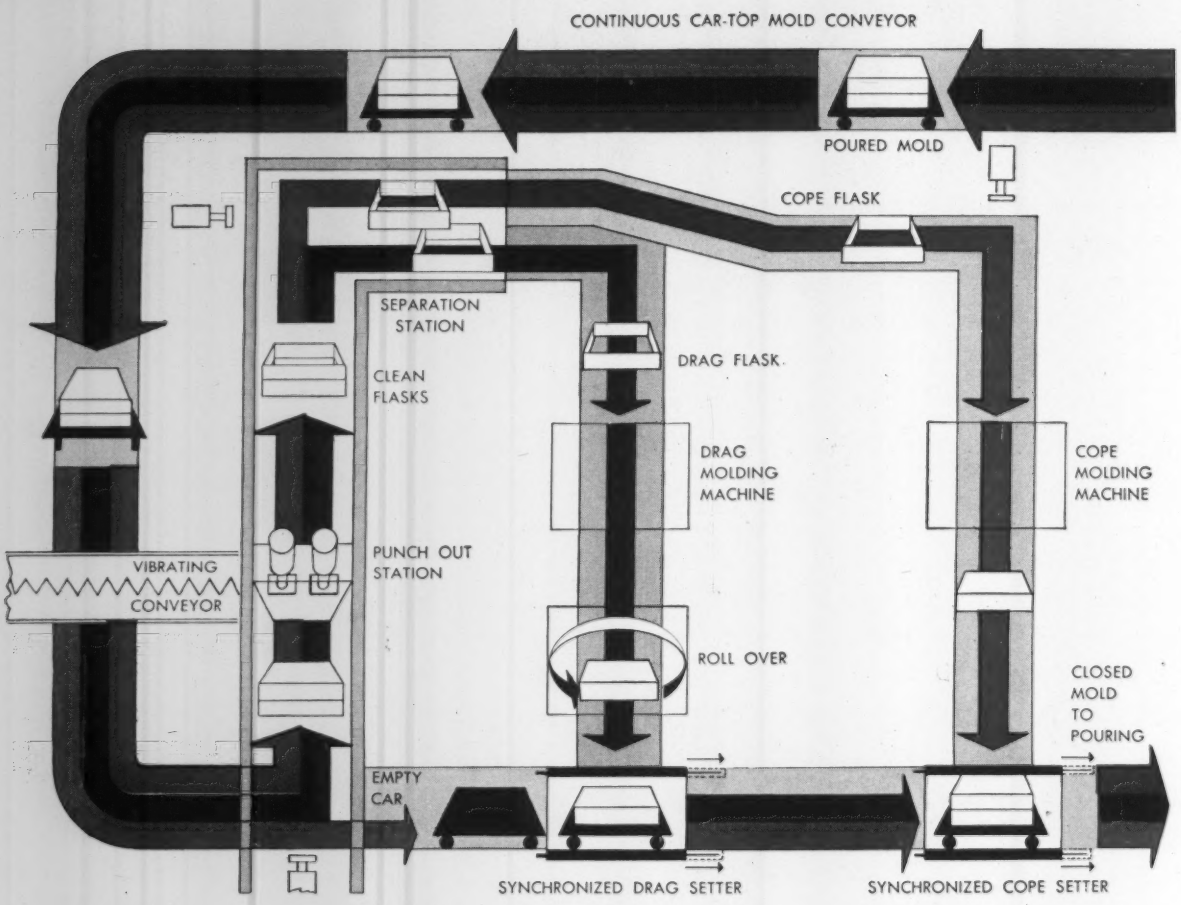
A PENTON PUBLICATION




# NEW AUTOMATIC MOLD HANDLING SYSTEM

## ..ANOTHER EXAMPLE OF PLANET VERSATILITY

Custom designed systems, such as the automatic mold handling system shown in the above diagram, have helped build Planet Corporation's reputation throughout industry as a *versatile* organization . . . as an organization with solutions to the most perplexing production, materials handling and automation problems.

This system, installed in a large automotive foundry, automatically handles molds from start to finish. After molding, the drag and cope flasks are brought together and gently and accurately closed in position for pouring. Following pouring, the castings and sand are punched out, the clean flasks are separated and recirculated through the system . . . *a system which will pay for itself in less than one year.*

This is only one example of "PV" . . . *Planet Versatility.* Planet "PV" engineers have automated many types of production lines, built bulk and unit materials handling systems, designed complete plants, developed the world's only true universal transfer device . . . in fact, they are experts on all types of special handling and automation machinery, and materials handling equipment.

No matter what your problem . . . no matter how big or difficult your problem, "PV" will save your time in finding cost-saving, efficiency-increasing solutions. Let Planet demonstrate how its versatile engineering skill, and production and erection know-how can help you . . . you'll find *it pays to plan with Planet.*

Circle 651 on Page 19

Carl: This sounds like what we've been looking for. Suggest you write to them. CF

# COOPERATIVE CREATIVE-ENGINEERING

## • COOPERATION IN IDEAS

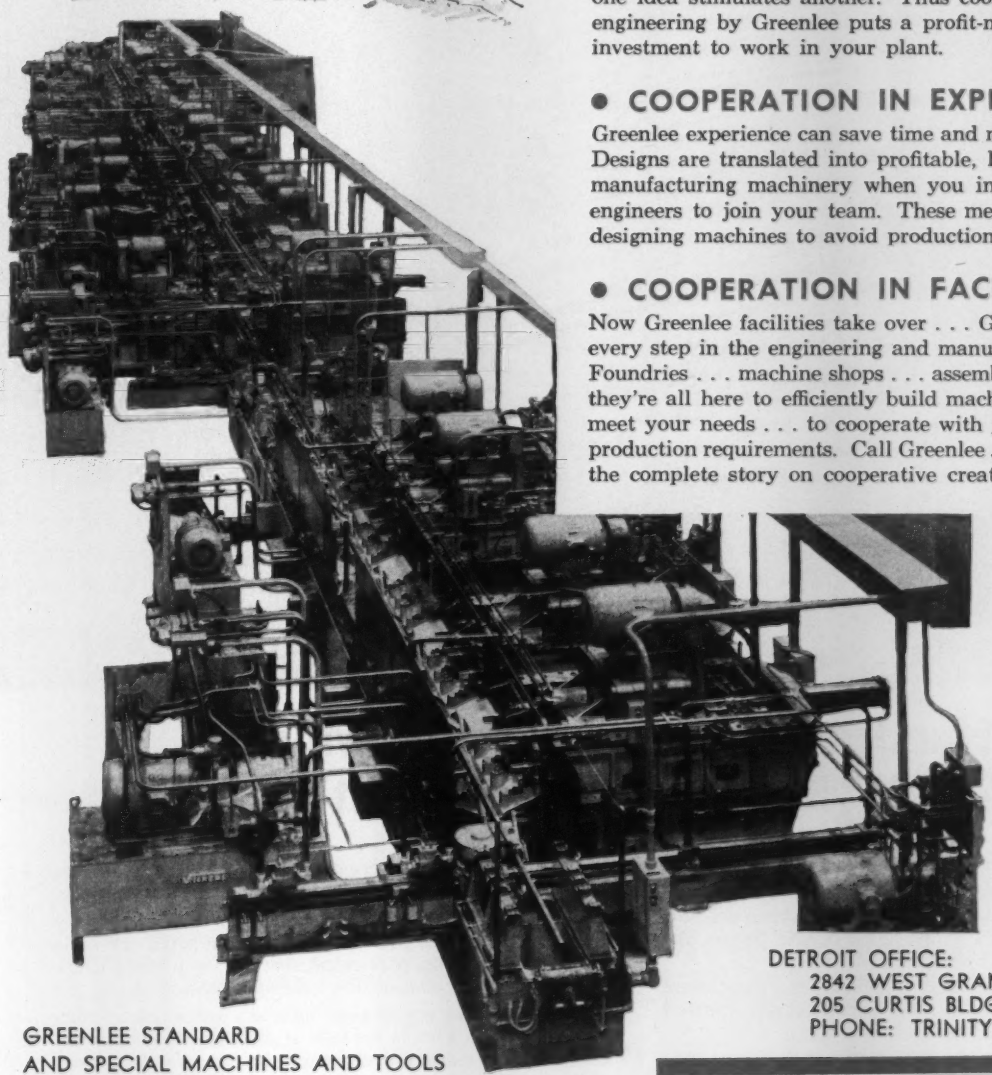
Greenlee engineers work with your men at all levels of management, production, and engineering. They gather and exchange information based on broad experience. These contacts accelerate creative thinking . . . one idea stimulates another. Thus cooperative creative-engineering by Greenlee puts a profit-making investment to work in your plant.

## • COOPERATION IN EXPERIENCE

Greenlee experience can save time and money in your plant. Designs are translated into profitable, low-cost manufacturing machinery when you invite Greenlee engineers to join your team. These men know the art of designing machines to avoid production problems.

## • COOPERATION IN FACILITIES

Now Greenlee facilities take over . . . Greenlee controls every step in the engineering and manufacture of machines. Foundries . . . machine shops . . . assembly floors . . . they're all here to efficiently build machines to meet your needs . . . to cooperate with you in meeting production requirements. Call Greenlee . . . let them give you the complete story on cooperative creative-engineering.



PRODUCTION MACHINERY
GREENLEE

Miss Jones: write for available literature and mail this to Joe Thompson CF

DETROIT OFFICE:
2842 WEST GRAND BLVD.
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GREENLEE STANDARD
AND SPECIAL MACHINES AND TOOLS

- Transfer-Type Processing Machines
- Multiple-Spindle Drilling and Tapping Machines
- Six and Four-Spindle Automatic Bar Machines
- Die Casting Machines and Trim Presses
- Hydro-Borer Precision Boring Units
- Core Box Handling Equipment for Foundries
- Specialized Woodworking Machines
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- Hydraulic Tools for Electricians, Plumbers, Contractors

*Machines designed with the future in mind*

**GREENLEE**
**BROS. & CO.**
1747 MASON AVE.
ROCKFORD, ILLINOIS

Joe: These people have a lot of machines in the Detroit area — look them over and let me know your reaction. CF

Circle 654 on Page 19

# Hundreds of good reasons why Clark "PM" Relays are worth waiting for

The word is out about the most complete, integrated line of control relays available today.

If your shipment of Clark "PM" Relays has been delayed, please be patient. There's a very good reason. Seems like *everybody* wants them.

It all began when Clark first announced the completion of a *full line* of "PM" Relays. We were literally snowed under by an avalanche of orders.

We're happy to report, however, that our manufacturing facilities have been expanded to meet the demand and we're rapidly catching up—even though the avalanche continues.

Is it any wonder when you consider the many advantages the Clark "PM" Relay line offers: modular construction that makes possible integrated uniformity, compactness and flexibility . . . neater, more uniform panels . . . the greatest possible use of every square inch of valuable space.

Is it any wonder also, when you consider that *every* relay in the Clark "PM" line is manufactured with the same careful attention to detail that has long made Clark *"the standard of quality"* for industrial control.

No time-saving production short cuts are worth sacrificing this quality, even in the face of the tremendous demand created by customer preference. In fact, we're sure our customers wouldn't have it any other way.

Your Clark Controller sales representative or distributor will be glad to give you more reasons why Clark "PM" relays are your best control relay buy—well worth waiting for. Contact him or write direct to Clark Controller. 9R2

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The CLARK CONTROLLER Company

Everything Under Control • 1146 E. 152nd St. • Cleveland 10, Ohio

IN CANADA: CANADIAN CONTROLLERS, LIMITED • MAIN OFFICES AND PLANT, TORONTO

OCTOBER 1959
Vol. 6—No. 10

# AUTOMATION

A PENTON PUBLICATION

*The Magazine of Automatic Manufacturing Operations*

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# automation outlook

### EMPHASIS ON MANUFACTURABILITY

". . . the last half century has seen many new products, and changes to old products, introduced into our daily living pattern. These for the most part resulted from new technical discoveries or new materials. The next half century will see as many more changes in things familiar to us, but these changes will be dictated more by the necessity to manufacture them with a minimum of manual labor. . ."—*Rodney C. Gott, executive vice president, American Machine & Foundry Co., see page 42.*

### NO CHOICE OF ASSEMBLY METHOD

". . . we do not feel that it is necessary to rehash a lot of generalities concerned with the old question—'To automate or not to automate.' Most of us directly concerned with high volume assembly work have found that the pressure of competition leaves us with no choice. . ."—*George L. Weiser, chief process engineer, Delco-Remy Div., General Motors Corp., see page 56.*

### TOO LITTLE STUDY

". . . there has been far too little consideration given to processes and manufacturing research by the metal cutting industries. In the past, and it seems still to be true today, only those high production manufacturers with relatively few different parts have been the ones to indulge in the luxury of manufacturing research. Other manufacturers excuse themselves from such activity as this by claiming too small quantities of any one part to justify such expense. This latter and most common procedure has placed improvements in processes and manufacturing techniques more in the lap of Lady Luck than in the mill of industrial ingenuity. It might well be that much more attention and devotion of effort to the study of processes and manufacturing research are the best ways to combat the competition of the less expensive foreign made products . . . It is time for us all to be awakened to the blunt, hard facts that too little study has been given by all industry toward better processes and manufacturing techniques. . ."—*L. W. Scott Alter, president & general manager, American Tool Works Co.*

### DEFINITE PROGRESS

". . . we feel definitely that analyses of processes and manufacturing research have been accelerated in the past year or so. Our mass production customers, as well as ourselves, are more deeply involved in these than ever before. The problems of integration and communication in manufacturing have come in for special consideration. Principles of continuous flow in processes are being applied in new ways. Electrical and mechanical devices have been simplified to a degree where more automation can be considered very practically. . ."—*Jervis C. Webb, president & general manager, Jervis B. Webb Co.*

### SIMPLIFY, THEN AUTOMATE

". . . automation of paperwork will certainly speed it up, but if you automate already wasteful paperwork, it is like compounding a felony. Ahead of mechanization should come the searching study, the selective analysis, and the firm action to discard all duplicate, extra controls, and all the nice but unnecessary records and reports. . ."—*Robert N. Bayless, executive vice president, Seaman & Co. Inc.*


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BPA NBP




Circle 656 on Page 19→

# . . . Fluid Power news

**REPORT NO. 11,704**
**Power and Control for New Lock Gates**

From Oilgear Application-Engineering* Files

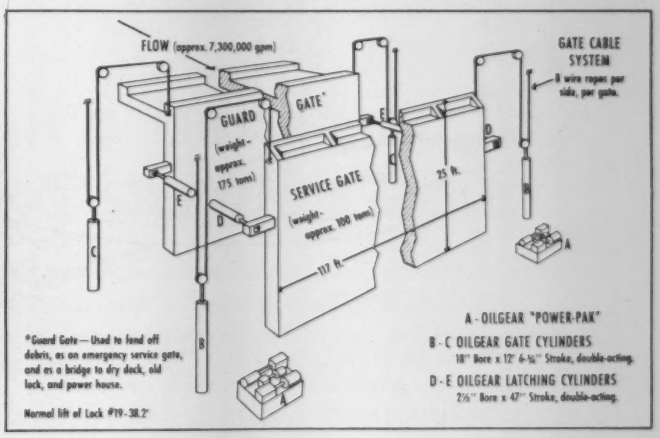
## HOW OILGEAR AE* HELPS THE ARMY ENGINEERS SPEED MISSISSIPPI RIVER TRAFFIC

**CUSTOMER:** *Corps of Engineers, U. S. Army, North Central Division, Rock Island District*

**DATA:** Power and control system for lifting, lowering, and latching the 110-ft, single leaf, vertical lift, upper service and guard gates on new 1200-ft Mississippi River Lock #19 at Keokuk, Iowa.

**REQUIREMENTS:** 1. Foolproof, dependable, fast operation. 2. Simple, automatic, three-speed control from central station, interlocked electrically with lower miter gate, tainter valves, and lock water level. 3. System must incorporate: (a) Automatic latching, (b) Skew control to keep gates level during lifting and lowering, (c) Provision for emergency closing, (d) Automatic positioning for controlled supplemental fill of lock chamber over service gate top, (e) Additional lift-travel for cable and seal servicing, (f) "Fail-safe" operation in event of power failure.

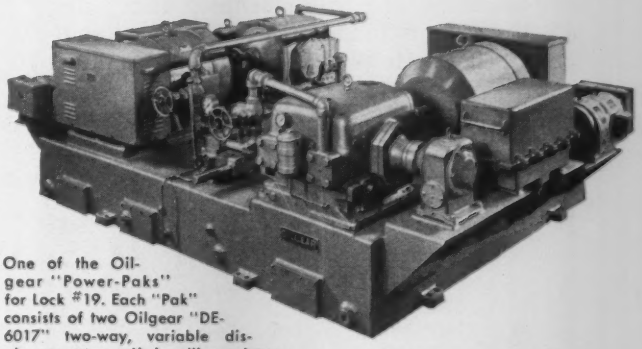
A typical "tow" entering new Lock #19 from upstream. In "locking-down" it will pass over the Oilgear-powered upper guard and service gates. Several "tows" can simultaneously "lock-thru" intact. New upper guard gate also serves as an access bridge to a dry dock and the old lock visible to the right of the new lock.


FLOW (approx. 7,300,000 gpm)
GATE CABLE SYSTEM
8 wire ropes per side, per gate.
GUARD
(weight-approx. 175 tons)
GATE*
SERVICE GATE
(weight-approx. 100 tons)
25 ft.
117 ft.
A
B
C
D
E
*Guard Gate — Used to fend off debris, as an emergency service gate, and as a bridge to dry dock, old lock, and power house.
Normal lift of Lock #19-38.2'
A - OILGEAR "POWER-PAK"
B - C OILGEAR GATE CYLINDERS
18" Bore x 12' 6-½" Stroke, double-acting.
D - E OILGEAR LATCHING CYLINDERS
2½" Bore x 47" Stroke, double-acting.

**SOLUTION:** An Oilgear *Application-Engineered* Fluid Power System which surpasses all originally specified requirements . . . as shown above in simple schematic form. This system consists of two Oilgear "Power-Paks" (A), four Oilgear custom, double-acting gate cylinders (B-C) — with integral solenoid pilot-operated brake valves, and four Oilgear custom, double-acting gate-latching cylinders (D-E). Entire upper gate control system is interlocked electrically with the lower miter gate and tainter valves for maximum operating safety. In event of power failure, solenoid pilot-operated brake valves, integral with cylinders, stop gate movement for "fail-safe" operation. Automatic skew control prevents "cocking" or binding of gates. A difference of 1½" in side height automatically reduces displacement of leading gate cylinder pump to allow lagging cylinder to catch up. Gate "down-cycle" power regeneration is an outstanding "Oilgear-plus" feature that furnishes exceptional electric power economy . . . utilizes the downward load on cylinder fluid to drive the Oilgear pumps as motors, reducing electrical power input. To speed lock filling, upper service gate automatically lowers to a supplementary fill position permitting controlled flow of water over gate top. Gate holds this position until water levels of upper pool and lock chamber are equalized, and automatically proceeds down at high speed. If water levels are equalized prior to start of cycle, gate does not stop at supplementary position. "Fill" time is only 10 minutes, drain time — 9¼ minutes. Entire "lock-thru" time for an 11-barge tow has been reduced from 7¼ hours to approximately 20 minutes with this new lock. In emergencies, upper gates can be raised or lowered against full river flow. Oilgear *Application-Engineered Controlled Motion Systems* are simplest to install, operate, and maintain . . . require less power to operate, reduce installed costs . . . are complete systems for specific applications — with one responsibility for the entire system.

* * *

Similar Oilgear systems are operating the St. Lawrence Seaway Eisenhower Locks, the Monongahela River Locks, the Bayou Boeuf Locks, the Dalles Locks, the McNary Lock — all projects of the Corps of Engineers . . . as well as operating miter gates, tainter valves, capstans . . . shipboard steering and flanking gear, winches, catapults, elevators, mobile oil drilling barges, and in all phases of industry.



One of the Oilgear "Power-Paks" for Lock #19. Each "Pak" consists of two Oilgear "DE-6017" two-way, variable displacement, radial rolling piston pumps coupled to 50-hp electric brake-motors; two electric pilot gearmotors, reducers, limit switch boxes, and right angle worm-gear drives to pump controls. Also included are a manually operated Oilgear change-over valve, an Oilgear "HG" constant displacement axial piston pump for operating the latching cylinders — all on a custom oil reservoir base . . . completely wired and piped, ready for installation. Each Oilgear variable displacement pump is piped to one of the large gate cylinders. In the event that pump maintenance or inspection is required, the manual change-over valve permits either pump on the "Pak" to be idle while the other pump operates either the service or guard gate.

***for the lowest cost per year . . . it's Oilgear!***

*For practical solutions to YOUR rotary or linear drive and control problems, call the factory-trained Oilgear Application-Engineer in your vicinity. Or write, stating your specific requirements, directly to . . .*


**THE OILGEAR COMPANY**

*Application-Engineered Controlled Motion Systems*

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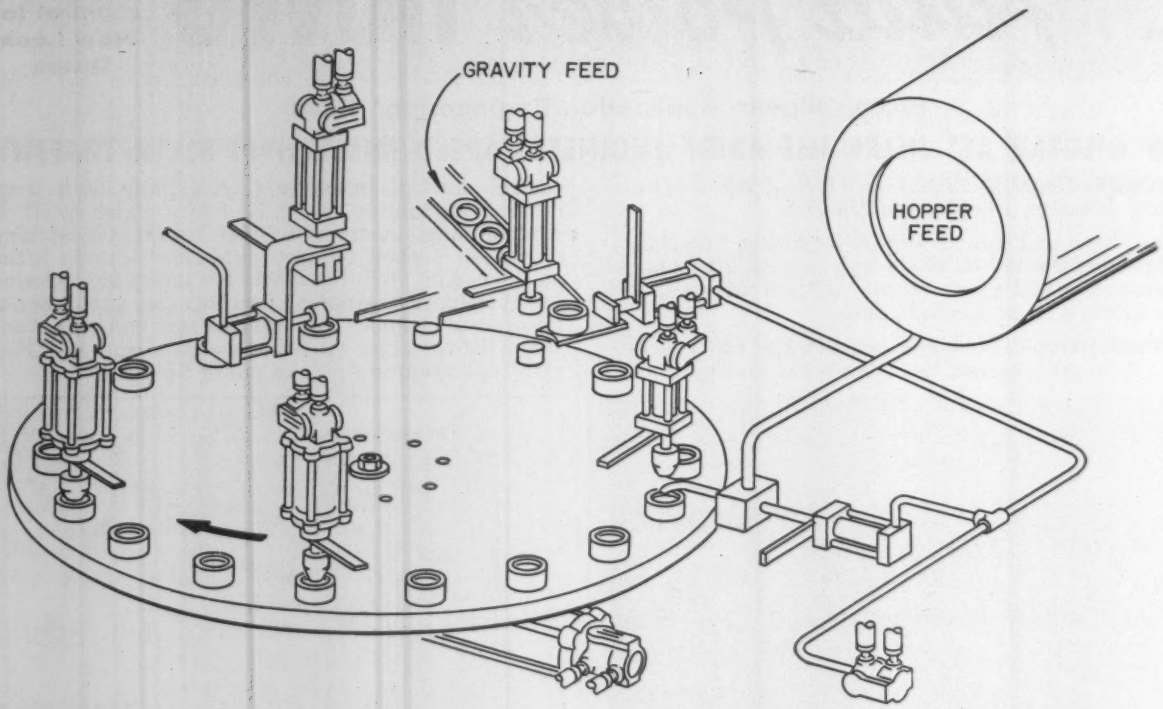
# THIS BELLOWS "SPOT-A-MATION IDEA" SAVED $82,754.00




Engineers at the Naval Ordnance Plant, Macon, Georgia, were given the assignment to "effect major production economies" in the assembling of explosive components for ordnance use. The operations were being performed manually by 33 people. The engineers designed and built two automatic assembly machines, each using a Bellows Rotary Index Table and five explosion-proof Bellows Air Motors. The savings on direct labor costs alone on one contract amounted to .0109 man-hours per assembled part for a total dollar savings of $82,754.00.

This same basic idea can be readily adapted to handle an almost unlimited range of small parts assembly procedure: staking, crimping, screw or stud placement, welding partial or complete small assemblies, etc.

It is typical of the many ways ingenious engineers "spot-automate" costly and troublesome production centers with Bellows "Controlled-Air-Power" Devices.

Chances are that many such opportunities exist in your plant. Why not investigate today?

Air Force Photo by Robins AF Base, Ga.

*The savings of $82,754.00 made through these automatic assembly units are based on direct labor costs and are exclusive of any possible savings from reduced overhead. In addition, 1000 sq. ft. of floor space was released for other operations.*

***THIS "SPOT-A-MATION IDEA" FILE IS YOURS ON REQUEST***

**Contains installation data, wiring diagrams and equipment lists for the assembly idea sketched above, as well as a score of other "Spot-a-motion" ideas you can use. Write Dept. AU-1059, The Bellows Co., Akron 9, Ohio.**

1492-B

## The Bellows Co.

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

**AKRON 9, OHIO**

OTHER INDUSTRIAL DIVISIONS OF IBEC: Sinclair-Collins Valve Co., Valvair, Akron, Ohio • V. D. Anderson Co., Cleveland, Ohio



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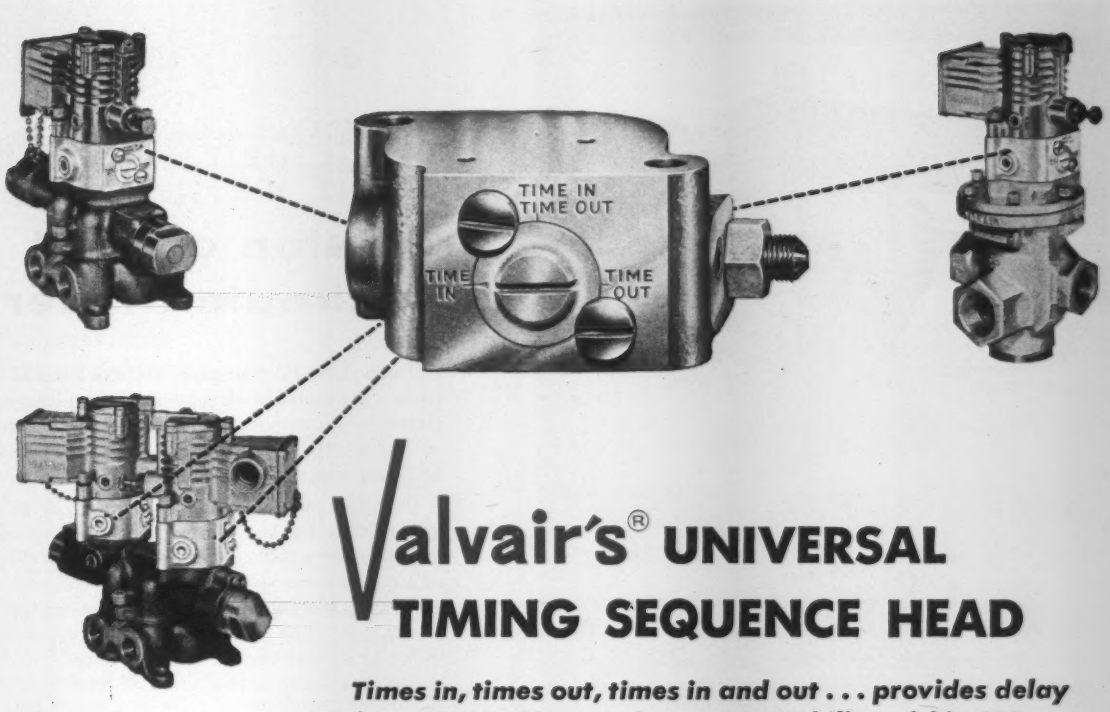
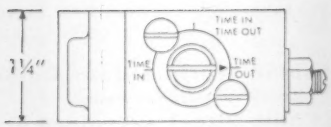



# Valvair's® UNIVERSAL TIMING SEQUENCE HEAD

***Times in, times out, times in and out . . . provides delay from 0 up to 30 seconds . . . repeatability within 2% . . . changes function without disassembly . . . for use with any Valvair Speed King or Inline Valve***




For accurate control, to simplify circuits, to eliminate timers and relays, to lower control component installation and maintenance costs, use Valvair's universal timing sequence head. This unit is supplied in two types; one for direct mounting between the pilot and valve body; one for direct mounting on the valve body, with remote pilot control.

Function can be changed in seconds, *without disassembly* and with line pressure on the valve. Just loosen the lock screws slightly, turn the indicating barrel to the desired function mark, then tighten the lock screws.

A port is provided for installation of accessory reservoir capacity . . . delay can be extended up to several minutes. And, the Valvair name on this unit is your assurance of sound design, quality construction, micro-accurate performance and multi-million cycle dependability!

Find out how Valvair's sequence head can provide the results you want, at a cost saving you'll like, on the new equipment you're designing or on existing machines you're up-grading. Yes, this sequence head can be used on your present SPEED KING and INLINE valves, too. Ask your Valvair or Bellows Field Engineer for recommendations . . . they're located in over 125 major industrial cities.

***For more information, write for Bulletin E-1A. Address Dept. AU-1059, Valvair Corporation, 454 Morgan Ave., Akron 11, Ohio.***

Valvair AKRON 11, OHIO

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8079



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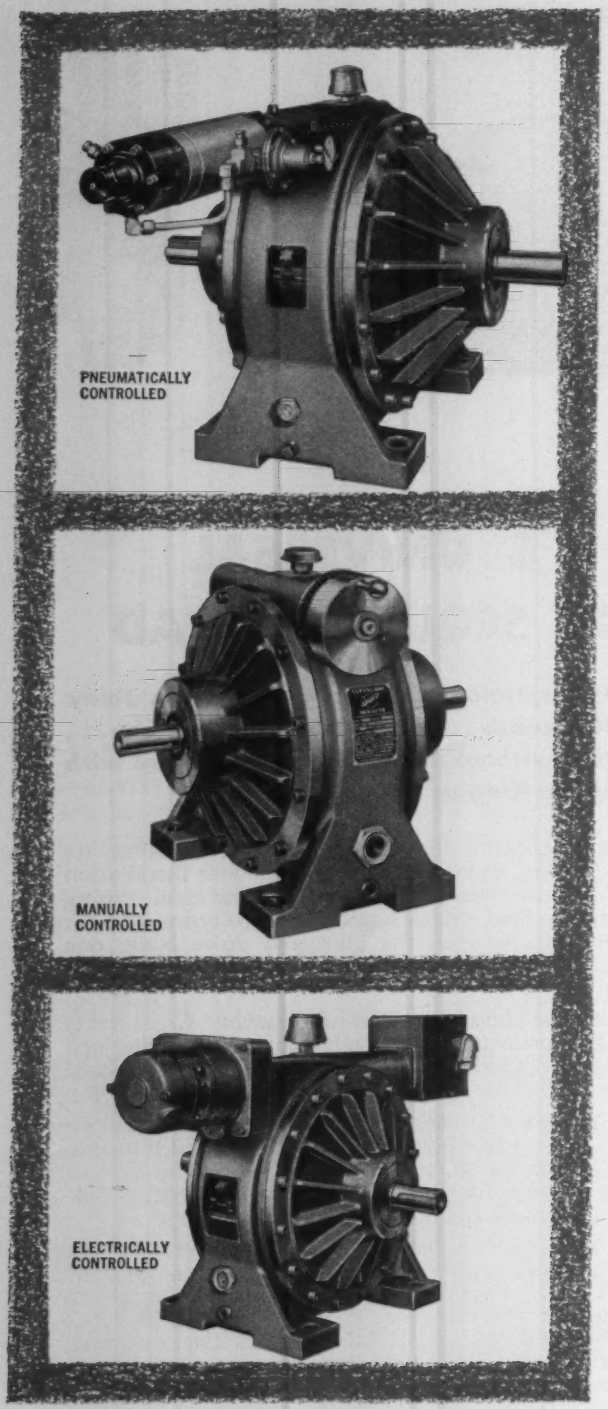


# with Cleveland Speed Variators... precision control is a simple matter

Cleveland Speed Variators — mechanical traction-type variable drives with stepless speed control — provide both increase and decrease of output speed on a range up to 9:1 from a constant speed power source.

Infinitely variable speed regulation is provided with instant, smooth change by either manual, automatic, or remote control. Precise adjustments are easily made with accurate adherence to settings. Some typical examples:

**For the Chemical Industry**
In rubber processing seventeen variators provide necessary process flexibility when changing production from one type synthetic rubber to another.

**For the Automotive Industry**
Variators give accurate control of assembly line speeds to control conveyor output rates.

**For the Tobacco Industry**
Variators make delicate adjustments for electronic beta gage controller.

**For the Steel Industry**
Variators provide remote control speed change on processing line conveyor.

**For the Metal Working Industry**
Variators permit fast, accurate adjustment of machining speeds for metals, from magnesium to 38 Rc steel.

**For the Wire Products Industry**
Variators control four reels simultaneously — and without slippage.

**In Ore Processing**
Variators easily adjust rate of material feed to hammermill.

**In Material Handling**
Variators control movement of steel tubes through 176-roll annealing furnace.

**The Cleveland Worm & Gear Company**
***Speed Variator Division***
**3265 East 80th Street, Cleveland 4, Ohio**

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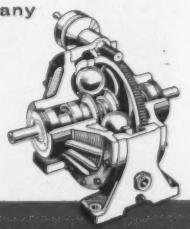
*Sales representatives in all major industrial markets.*

*Send for your free copy of Bulletin K-250. It gives the complete Variator control story.*



**HOW IT WORKS**

Power is transmitted from input shaft to output shaft through alloy steel driving balls which are in pressure contact with discs attached to the two shafts. Relative speeds of the shafts are adjusted by changing the positioning of the axles on which the balls rotate (see cutaway view, right).

**CLEVELAND SPEED VARIATOR**



*Circle 659 on Page 19*

# AUTOMATION news

Today's events and developments in the field of automation

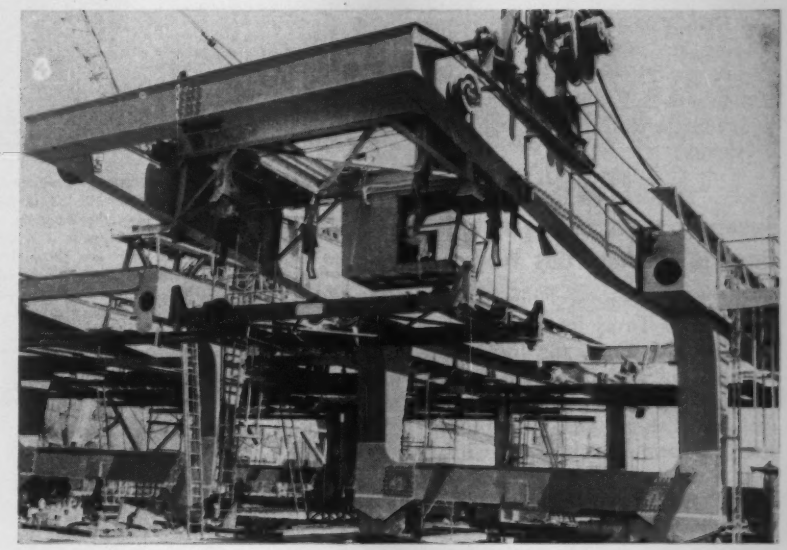
## Annual Hydraulics Conference Covers Industrial Applications

INDUSTRIAL hydraulics has played an ever increasing role in the rapid growth of modern industry during the last 25 years. Each year, the most up-to-date information on both the fundamental and the applied phases of industrial hydraulics are discussed at a National Conference on Industrial Hydraulics sponsored by Illinois Institute of Technology. This year's meeting will be on October 22-23 at the Sherman Hotel, Chicago.

A general session, eleven technical sessions, two luncheons, and a banquet comprise the conference whose over-all theme is "Looking Ahead to the 1960's." In the eleven technical sessions, the following areas of interest will be covered: Hydraulic components and accessories, low and high pressure pneumatics, hydraulic pumps, automatic machine tools, materials forming machinery, mobile equipment, servomechanisms and systems, space hydraulics, aircraft systems, automotive equipment, and hydraulic fluids.

The annual banquet will feature a report on the transpolar voyage of the nuclear powered submarine, *U.S.S. Nautilus*, by its Reactor Control Officer, **Lt. Steven A. White, USN.** The two luncheons will add a light touch to the conference with presentations by two sports celebrities.

The National Conference on In-



UNDER construction at Pacific Coast Engineering Co. are six automatic ship-loading cranes (one shown above) for installation on two cargo ships of Grace Lines Inc. Each major hold of a ship will be divided into 36 equal size spaces, providing for the maximum pattern of 6 rows of 6 cargo containers. Other patterns are possible, determined by the ship's configuration. On a control console in the crane cab will be a pattern of 36 pushbuttons. After a crane structure has been positioned over a row of containers, the operator pushes a button for the container to be removed from the hold. The hoist trolley automatically moves the lifting spreader over the proper container, lowers the spreader until locks on the spreader engage locks on the container, lifts the container out of the hold, and moves the container to a position over the dock. The crane is then manually controlled from the dock for loading the containers onto trailers or flat cars. After the spreader is disengaged, the hoist lifts the unit to complete a full cycle. The operator then pushes another pushbutton for the next container. Containers can be automatically loaded into the ship's hold in a similar manner. The crane control system was designed and built by Rundel Electric Co.

**An AUTOMATION Extra**

### A NEW SOURCE FOR PRODUCT INFORMATION

AUTOMATION is preparing the first edition of an **Annual Product Review** for distribution the latter part of this month. This new service for our readers will offer a complete and concise listing of automation equipment, products, components, and services which are available from advertisers in AUTOMATION.

The 1959 issue of the product review will contain information covering over 400 separate items. Each item is indexed for easy reference and is listed under one of 32 different product classifications. All literature and booklets mentioned in the comprehensive references will be available to our readers at no charge.

A complimentary copy of the **Annual Product Review** will soon be mailed to all regular recipients of AUTOMATION magazine. This list is published for your convenience to help you solve your automation problems. The editors of AUTOMATION believe that it will continually prove valuable as a handy reference for automation information.

dustrial Hydraulics is a nonprofit, noncommercial undertaking sponsored by Illinois Institute of Technology with co-operation of the hydraulics industry and various engineering societies. The major aim of the conference is to elevate the general level of technical knowledge by holding an annual meeting, where papers are presented and discussed, and by an NCIH sponsored educational program in hydraulics at the university.

## Supervisory Control System To Operate Offshore Gas Well

TURNKEY contract has been awarded to Texas Instruments Inc. by Gulf Oil Corp. for the manufacture and installation of an automatic supervisory control system for an offshore gas well production platform near Corpus Christi, Tex.

The system will provide continuous chart records of individual well performances and other monitoring information as needed. All control and alarm information will be transmitted between the offshore platform and a land-based control site by means of a dual-wire submarine cable. The supervisory system will eliminate the necessity of keeping maintenance personnel on the platform, which is frequently exposed to severe weather conditions.

Heart of the unmanned offshore installation will be a digital code transmission system developed and produced by the GeoSciences and Instrumentation Div. of Texas Instruments. Similar supervisory control systems are used in oil and gas lease automatic custody transfer installations, process industries, plant supervision, and pipe line operations.

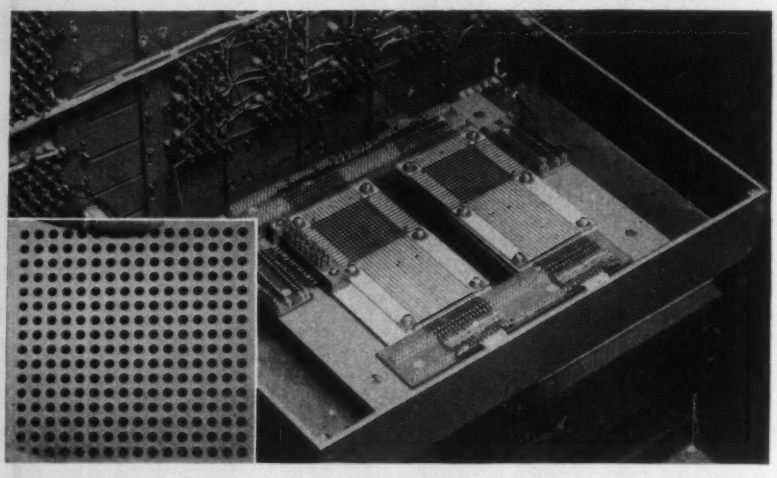
## Printed Circuit Problems To Be Aired At Fall Meeting of IPC

UNUSUAL program of interest to manufacturers and users of printed circuits is planned for the Fall meeting of the Institute of Printed Circuits on October 14 at the Sheraton Towers Hotel, Chicago.

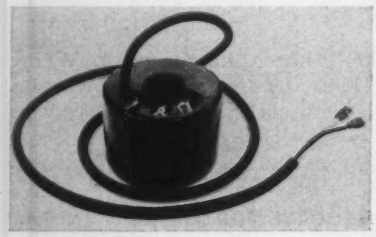
During the morning session, a panel of industry experts will discuss printed circuit costs. Speakers will cover the relationship of cost to dimensional tolerance requirements; to quality and reliability requirements; to length of the production run; and to the complexity of design of the printed circuit board.

A feature of the Fall program will be a panel of qualified producers and users to discuss the topic of "Make or Buy Printed Circuits." Panel members will represent independent producers of printed boards, manufacturers producing boards for their own use, and manufacturers who purchase printed boards from outside venders. Speakers will discuss such factors as the extent of capital investment and engineering needed to perform adequately, and the return on invested capital.

Additional information concerning the meeting can be obtained by contacting the Institute of Printed Circuits, 27 E. Monroe St., Chicago 3, Ill.



MAGNETIC-FILM computer memory developed by Lincoln Laboratory, Massachusetts Institute of Technology, has a capacity of 32 ten-bit words and a read-and-write cycle time of 0.8 microsecond. Inset shows the magnetic memory element which is designed to replace ferrite cores. Each memory element is a circular spot of Permalloy film evaporated on a thin glass substrate. The spots are 1.6 millimeters in diameter and spaced on 2.5 millimeter centers. Surrounding the installed memory elements in the experimental unit are transistor drive and sense circuits. The new memory system is being developed under Air Force contract for use in the TX-2 digital computer.

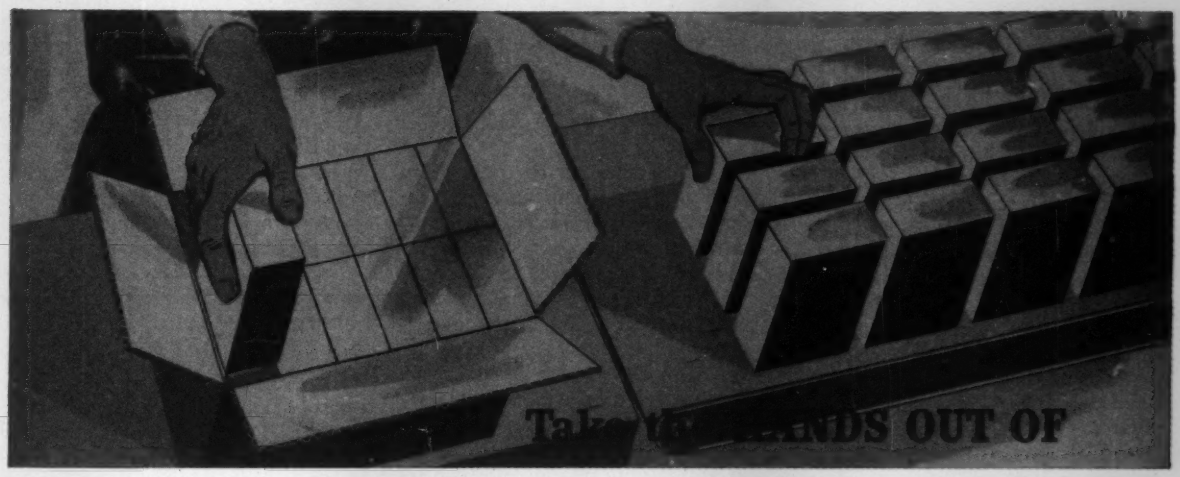


RELAY actuator developed by L & B Electronics is designed to energize relay coils when current as low as 4.5 amperes is sensed in a wire passing through the center of the toroid. Actuator has no moving parts, eliminates mechanical timers normally used in such applications as welding, and has no upper current limitation. Toroid is enclosed in an epoxy material and can be used in ac and dc current systems. Other models are available for milliampere actuation.

## Underwater Lightning Forms High-Strength Metals

HIGH-ENERGY spark forming process that creates "underwater lightning" to convert electrical energy into mechanical power has been developed by Republic Aviation Corp. The process is being used experimentally for certain metal-forming operations that normally employ conventional hydraulic press equipment.

The heart of the process is a device called a "spark bomb" that stores up electrical energy and then releases it with a force equal to 6000 horsepower. Electric power is fed into a battery of capacitors. Wires from the plus and minus terminals of the capacitors are attached to electrodes immersed in



# Product Handling

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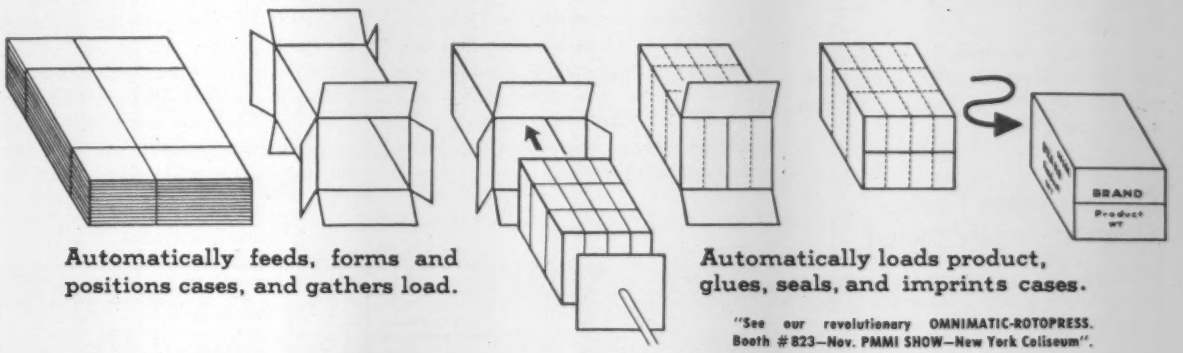


**Automatically feeds, forms and positions cases, and gathers load.**

**Automatically loads product, glues, seals, and imprints cases.**

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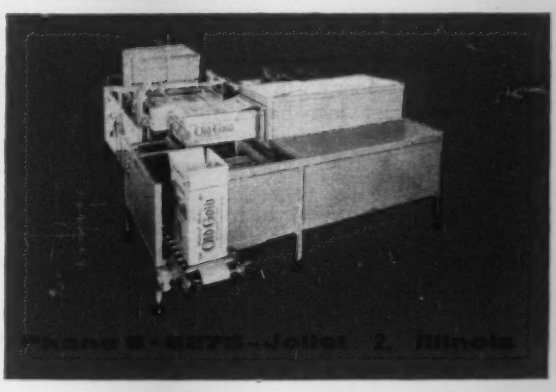
**For casing round, square, rectangular, or free-form packages of virtually any size.**

If you employ even one person per shift to hand-form cases, or to hand-pack, hand-seal or hand-imprint them, then it can pay you to install Packomatic equipment. And if you employ two or more people the savings can increase proportionately. Even a **complete** automated Packomatic line requires only a minute or two of attention at infrequent intervals to match the output of a dozen pair of hands. And in addition to reducing your direct labor production costs Packomatic can, by utilizing end-opening shipping cases, reduce paper-board costs up to 25%. And mechanically end loaded cases are stronger too, because the flaps give added resistance to weight and shock. In addition, they stack better because their uniformly flat sides enables keying of pallet loads. Write, wire or phone us for facts on how to reduce your casing costs.

PACKOMATICS include Case Sealers • Case Opener-Loaders • Case Packer-Gluers • Case Imprinters • Bale Sealers • Automatic Equipment for Shelf Carton Making, Feeding, Filling and Closing • Round Paper Can Mfg. Equipment

**J. L. FERGUSON COMPANY - Box 1226**

FOR EXAMPLE: This Packomatic machine at the P. Lorillard Co. automatically forms and positions cases, end-loads regular or king-size cartons of Old Gold cigarettes (60 cartons per case) and up-ends cases for sealing — at the rate of 400 cartons per minute, or nearly 5 million smokes per hour.



water. When a discharge switch is released, an "explosion" occurs, complete with lightning flash and thunderclap. The resulting spark travels through the water at extremely high velocity, creating a shock wave which is used to form metals.

According to **Adolph Kastelowitz**, director of manufacturing research for Republic, the spark bomb development offers a potential solution to the problem of working with high-strength metals. Some of the newer steel and titanium alloys have practically no stretchability and require complicated equipment of tremendous force to shape them to close tolerances and aerodynamic smoothness. The high-energy spark forming process appears to be a method of obtaining this magnitude of force with simple and inexpensive equipment. Republic is working toward eventual development of the spark bomb device as a standard machine tool. Such a tool would cost about one-tenth as much as a conventional hydraulic press and would take up a fraction of the floor space.

## Company Offers Turnkey Computer Process Control

PLANS for marketing a complete computer control system for industrial process plants have been announced by the Scientific and Process Instruments Div., Beckman Instruments Inc. The control package, built around the Beckman 123 Data System and a commercial digital computer, will provide equipment needed for applying computer control to a process or a complete plant.

According to **Roy F. Brown**, sales manager, the company will be "selling answers, not just hardware." Brown spelled out the major steps in applying computer control to a process.

1. Selecting a process which will benefit economically from computer control.
2. Determining instrumentation needed to provide necessary process data.
3. Installing a data system to collect data.
4. Simulating process by mathematical analog, utilizing data collected.
5. Determining size and type of computer required.
6. Programming computer and installing equipment necessary for supervisory control or "on-line" control of the process.

Beckman is prepared to offer unified responsibility for applying computer control. They have experience and capability in process design engineering, analytical instrument design, applications engineering, and computer technology. The company will provide a great number and variety of computer control building blocks.

## Test Drilling Service Eliminates Machine Setup Time

ENGINEERING service offered by Drillmation Co. Inc. will assist manufacturing engineers in determining what drilling procedure—short or deep hole—would be best for a particular manufacturing job. The company has developed a gun-bore test machine which can be used to determine the optimum feeds and speeds for gun-drilling, gun-boring, gun-reaming, tube-reaming, and trepanning operations.

The service is expected to eliminate setup time and experimenting normally required to determine the best method for machining parts. A sample part is submitted to the company and is drilled on the test machine. At the conclusion of the tests, all data for drilling the part will have been determined including expected production rates, tolerances necessary, coolant flow rates and pressures, feedrates, and spindle speeds.

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SCIENTIFIC apparatus maker has developed an automatic gaging and sorting machine which checks bearings and small parts to three-millionths of an inch tolerance, handling them as fast as 7000 an hour.

---

## Data Handling System Links Sales Offices With Plants

ELECTRONIC data processing system developed by the Radio Corp. of America will be coupled with a 12,850-mile teletypewriter network to handle sales orders and other information flowing between eight plants and 36 offices of the Owens-Corning Fiberglas Corp.

Twelve strategically located transmitting points will relay orders via

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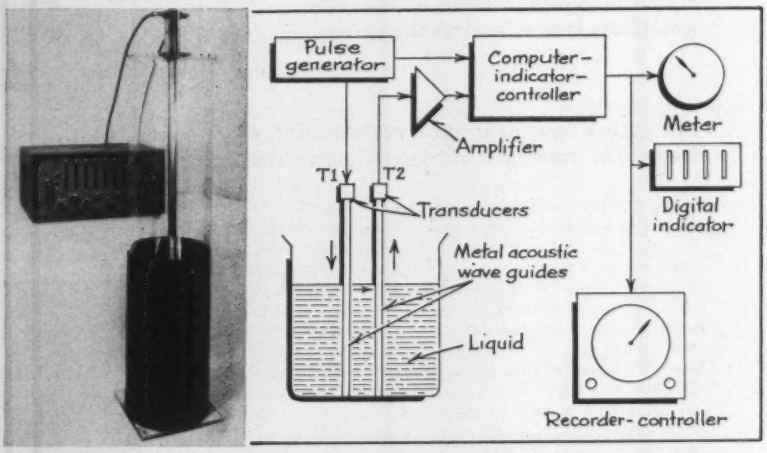
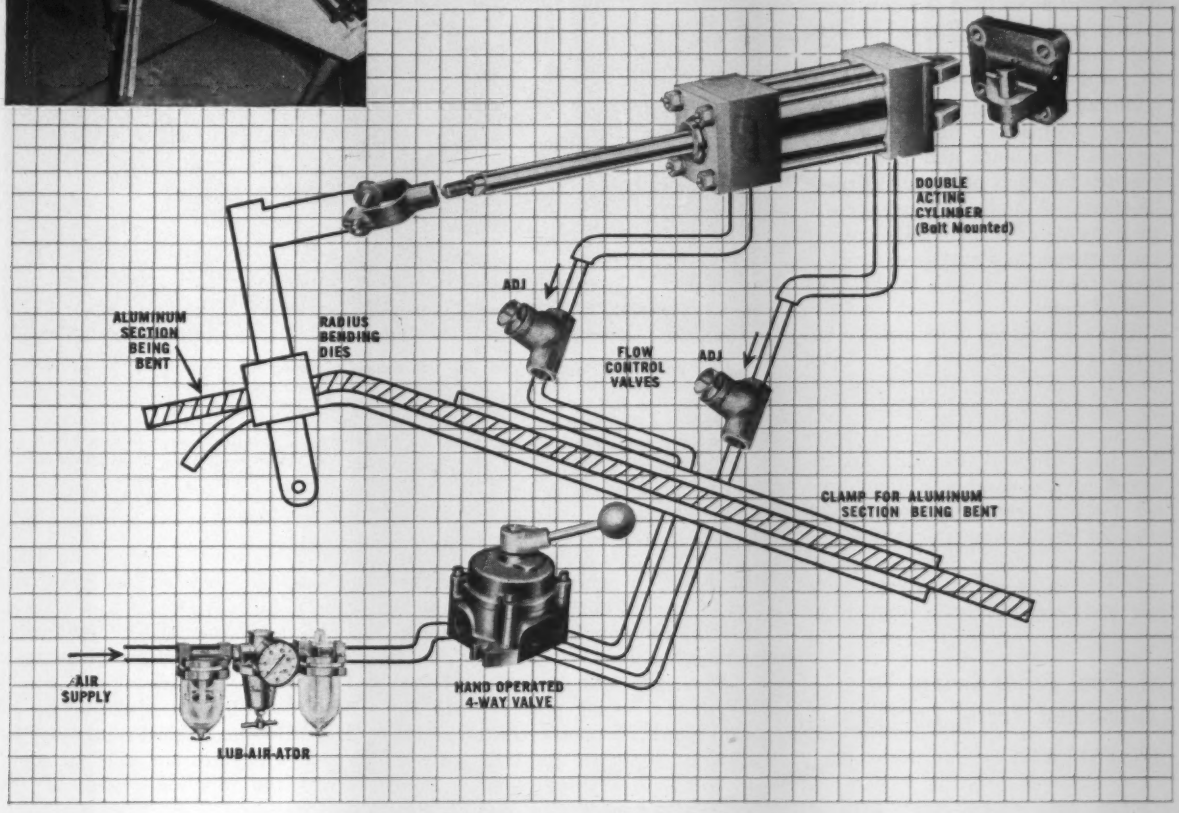



ULTRASONIC method for the continuous measurement of liquid levels has been developed by General Ultrasonics Co., Div., Acoustica Associates Inc. The system can be used to measure levels in liquid nitrogen, many slurries, thick oils, fused salts, and other fluid materials at temperatures ranging from cryogenic levels to molten metals. A short pulse is applied to the transmitting transducer T-1 and travels down the solid metal wave guide at a constant velocity. Upon reaching the surface of the liquid, some of the pulse energy radiates laterally into the liquid and travels up the receiving wave guide to transducer T-2. The transistorized measuring system automatically provides a readout based on time of pulse propagation between the two transducers and accurately measures the distance from the transducers to the liquid surface.

A typical example of how fabricators use Schrader. Schrader Air Products in the schematic perform a metal-forming operation at Lance Awning Corporation, Lake Worth, Florida. Power is supplied by a Schrader double-acting bolt-mounted air cylinder. By pressing the Schrader 4-way valve, the cylinder piston advances at proper speed, checked by Schrader flow control valves, bending an aluminum section to the desired angle. Reversal of the 4-way valve returns the cylinder and bending dies to rest, permitting removal of the bend section. "Air control provides a straightforward one-man job," says the Plant Manager. "Two men worked hard to form this radius bend on 25 parts per hour before a Schrader Air Cylinder was installed. Now one man forms 35."

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Air can save manhours . . . slash operating costs . . . upgrade practically any operation such as inspecting, assembling, testing and packaging. It can push, pull, hold, position and move work repetitively . . . make light of weight-lifting . . . accelerate production . . . unplug bottlenecks . . . all at unmatched low cost and drop-in-the-bucket maintenance.

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QUALITY AIR CONTROL PRODUCTS


*Circle 661 on Page 19*

teletypewriter to the Owens-Corning communications center in Toledo, Ohio. Order information will be entered in an RCA 501 data processing system for high speed processing and invoicing, as well as order and sales analysis reports. In addition to editing and sorting the order information, the system will provide price data and update inventory for each of the eight plant locations. A high speed printer will then turn out acknowledgments to the customer and supply order data to be transmitted back to the originating point.

Each individual order will be entered in a magnetic tape "open file." Orders will then be relayed to the manufacturing plant on a scheduled basis. When the order has been shipped, the data are relayed to the communications center for the preparation of invoices and for accounting purposes. Eventually, it is planned that the RCA 501 will help schedule production for all Owens-Corning plants.

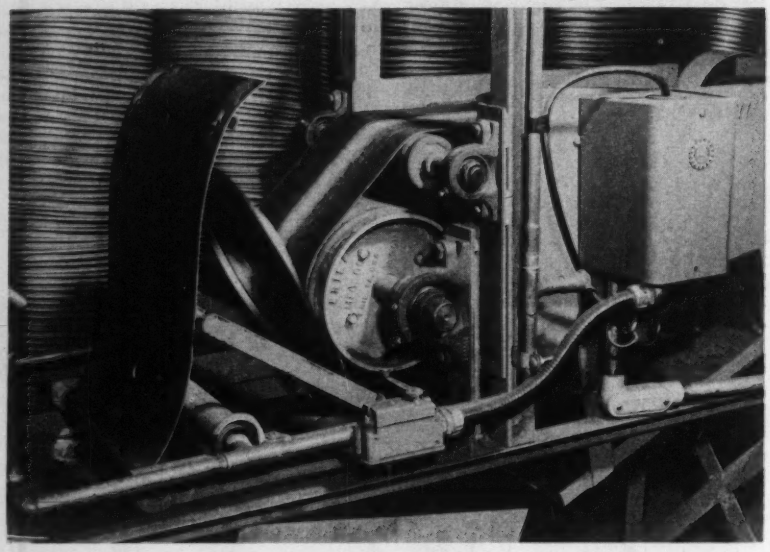
## St. Paul Depot Swings To Automated Parcel Handling

INSTALLATION has started on a new electronic sorting system for sacked and parcel post mail at Union Depot, St. Paul, Minn. The system is scheduled to be in operation by early December.

The St. Paul installation will be similar to an electronic sorting system in operation at the Pennsylvania Railroad depot in Philadelphia (See AUTOMATION, March 1959, "Electronic Memories Control Package Sorting System"). However, the St. Paul system will provide for 128 sorting points whereas the Philadelphia installation uses only 39 stations. In addition, the new installation will include a greater degree of mechanized transport of mail.

Engineering and installation of the new system will be furnished by Stewart-Warner Electronics, Div., Stewart-Warner Corp., who also handled the Philadelphia sorting system. Incoming mail of all sizes and types will be loaded automatically onto a powered conveyor belt and moved past a coding station. At this point an operator will note the parcel destination and key-punch this information into an electronic memory device.

When the sack or parcel reaches the proper sorting point, it will be transferred automatically onto an adjacent conveyor for transport to a specific outgoing train. The Stewart-Warner system was chosen, after consideration of several other types, by representatives of railroads using the St. Paul depot and the management of the St. Paul Union Depot Co.



AUTOMATICALLY reversing steel pail lids before lacquering is no problem at Inland Steel Container Co. The lids are conveyed from other operations on the upper conveyor belt leading from the right. As the belt makes a return loop, the parts are attracted to a magnetic pulley furnished by Eriez Mfg. Co. The pulley holds the lid until the belt has completed the return loop, then drops the flipped-over lid onto the lower conveyor leading off to the left. When lids do not require reversal, the shaped metal slide at the left of the pulley can be dropped into position to provide a bypass to the lower conveyor.

## GE Studies Tunnel Diode For Commercial Applications

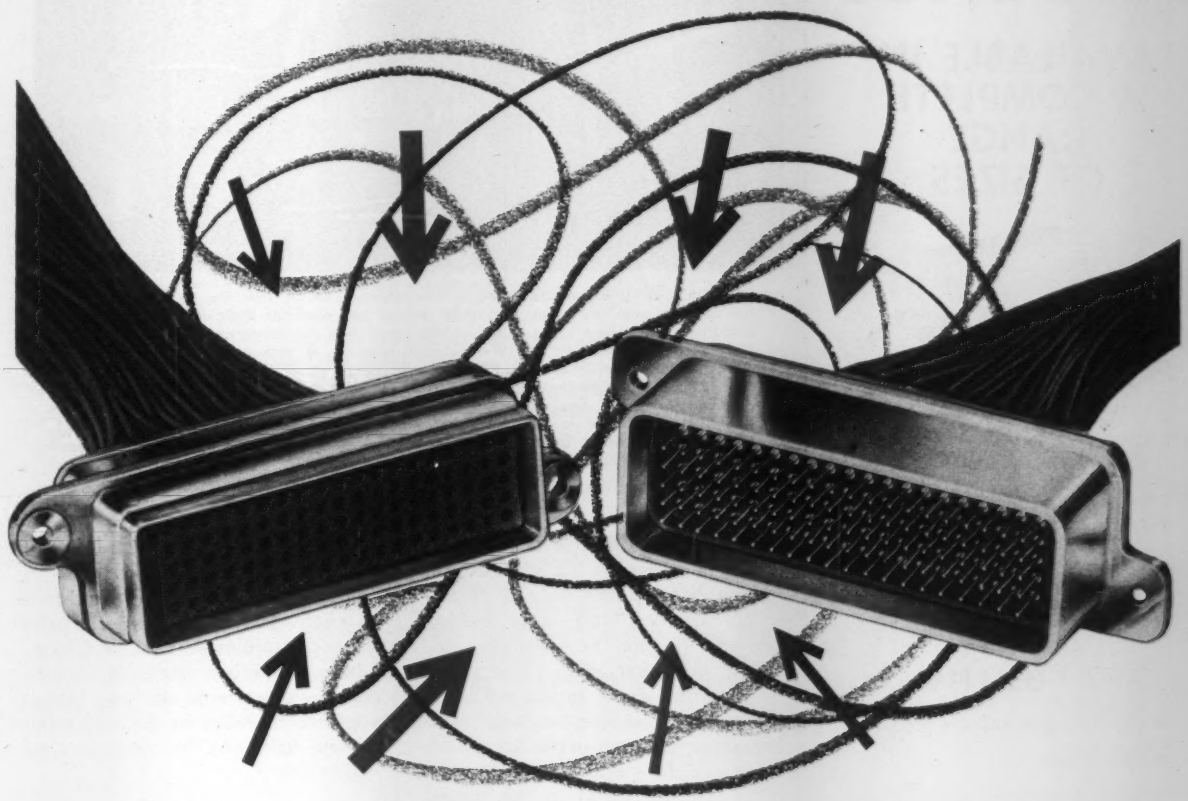
KEEPING abreast of the latest developments in the electronics field is like trying to maintain a leaky garden hose—as fast as one hole is fixed, another leak develops next to the repaired one. With so many companies concentrating on electronic development work, it is inevitable that new developments are announced before the ink is dry on reports of the now "older" developments.

The latest entry in the electronics field is the tunnel diode which is being developed by General Electric Co. First reported in 1958 by Japanese scientist **Leo Esaki**, the tunnel diode is related to a transistor, but operates on different principles and offers several advantages. The name "tunnel diode" comes from the physical phenomenon of "quantum-mechanical tunneling" by which electrons are able to move across the junction region of the device.

The theory of operation of the tunnel diode is quite involved, but can be simply explained by comparing it with the operation of a transistor. In a transistor, the electrons start from an emitter and diffuse across a base region to a collector. The speed of this amplification process is limited by the time it takes the electrons to traverse the base region. In the tunnel diode, the electrons traverse the base region instantaneously.

For example, in conventional amplifying devices a particular group of electrons is emitted and travels as a group to the collecting electrode. This requires some definite time to elapse. Operation of the tunnel diode, however, can be compared to the time it takes a signal to travel a length of copper wire. In this case, the signal is carried by the electric field of all the electrons in the wire, rather

# WHEN THE DUTY'S ROUGH AND THE CIRCUITS ARE CRITICAL



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Environmentally sealed or unsealed, *AMPin-cert* connectors are made in 50 and 100 position units and have a number of unusual features including: single or dual circuit leads per contact (in the 50 position unit) . . . crimp-on snap-in contacts with extra wire insulation support against vibration . . . aluminum shells for shock . . . cadmium plating for corrosion resistance . . . extended alignment skirts plus alignment bushings on shells to prevent coupling damage to contacts . . . alpha-numerical coding of all cavities.

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*Circle 662 on Page 19*

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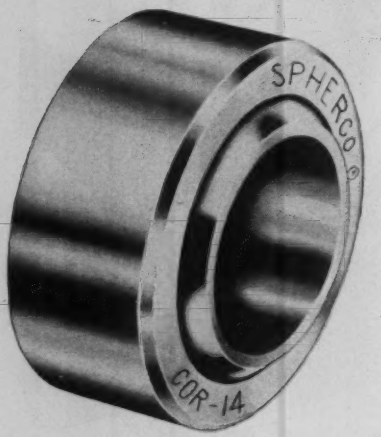


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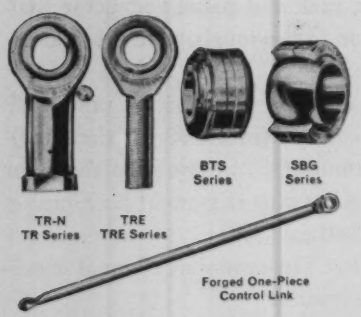


**WRITE FOR BULLETIN 257**

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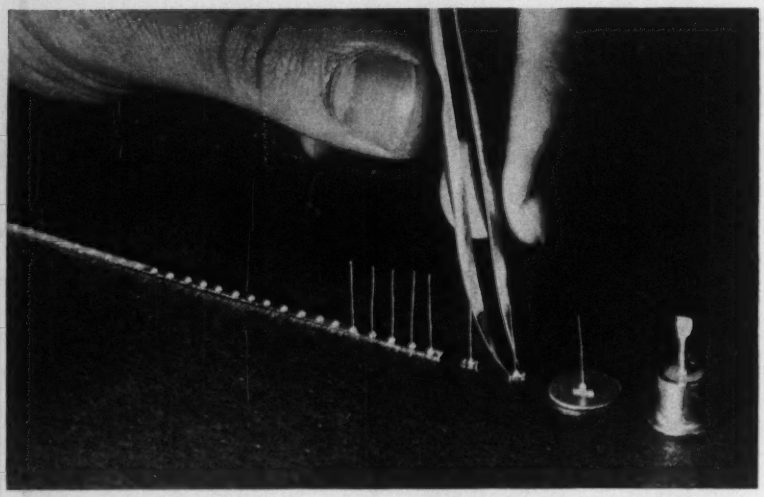
*Circle 663 on Page 19*

SCIENTISTS at Westinghouse Research Laboratories envision that the automatic manufacture of transistors and other solid state devices may someday approximate the handmade production line shown above. Key to the automation of this process is the revolutionary new technique discovered by Westinghouse scientists of growing germanium and other semiconductor materials as thin, flat, continuous strips or dendrites (See *Automation* News, July 1959, p. 10). As an automatic process, semiconductor devices would be formed as a continuous series of dots along the surface of a dendritic crystal. Electrical connections would then be made to the dots, after which they would be separated from the strip. Final operation would be the automatic insertion of the device into a plastic or metal container.

than by the motion of a particular group of electrons. Each electron in the wire moves only a microscopic distance, and those leaving one end are not the same ones entering the other end. The signal in a tunnel diode moves with the same rapidity as does a signal traveling along a copper wire.

The high speed at which electrical charges travel in the tunnel diode makes it possible for the device to operate at extremely high frequencies. Oscillation frequencies higher than 2000 megacycles have already been obtained, matching advanced transistor performance, and frequencies of more than 10,000 megacycles are expected in the near future. The device is also little affected by environmental conditions. Silicon tunnel diodes made by General Electric work at temperatures as high as 650F while conventional silicon diodes will not operate above 400F. They also work equally as well at the temperature of liquid helium which is a few degrees above absolute zero.

According to **H. B. Fancher**, general manager of the Semiconductor Products Dept., the tunnel diode is not expected to displace transistors or other active components in a circuit, but rather to improve their functional worth by working with them (such as an amplifier for cryotrons at temperatures close to absolute zero). Fancher envisions a whole family of tunnel diodes for such applications as oscillators, mixers, amplifiers, switches, drivers, and detectors with the two largest applications being in the communications field and in computers for logic circuits.

## System Transmits Punched Card Data between Two Stations

INTEGRATION of machine accounting and wire communications is now possible with the development of an advanced intercoupling system by Systematics Inc., recently acquired subsidiary of General Transistor Corp.

The new equipment permits the automatic transmission of punched card data at 60, 75, or 100 words per minute between locations linked by wire systems. It is applicable to any operation where punched card data must be relayed to a central location for recording and analysis. Immediate applications are in payroll reporting, inventory control, cost accounting, etc.

The system uses two intercouplers, one for data input and the other for data output. At the re-

# around the triangle

## COOL SPRINGS FOR HOT PLACES

What would happen to a coil spring if the ambient temperature suddenly rose to 1200 F? The answer is nothing if it were formed from a new precipitation-hardened alloy cobalt wire developed by National-Standard Co. Designated Alloy HS 25 or No. L-605, the new spring wire is designed to operate in temperatures from 400 to 1400 F. The wire is available in sizes varying from 0.171 to 0.018 inch diameter for use in automatic coiling machines.

## FORECASTS GROWTH OF SEMICONDUCTOR INDUSTRY

While announcing plans for a new transistor and rectifier manufacturing plant at Mountaintop, Pa., John L. Burns, president of Radio Corp. of America, gave an indication of the future growth of the semiconductor industry. According to Mr. Burns, the semiconductor industry will have a sales volume of approximately $350 million in 1959 to meet requirements for military, industrial, and entertainment equipment. Industry sales for these products in 1965 are expected to approach $650 million.

## EVERYONE CAN BECOME A PROGRAMMING EXPERT

Computer designers have long recognized the desirability of programming a computer with easily understood statements rather than cryptic codes which require experts to prepare, read, and correct. International Business Machines Corp. has developed a simplified programming procedure that combines English words with algebraic equations and logical expressions. The resemblance to conventional English is close enough so that a person unfamiliar with computer programming can be trained to read and write the language in a matter of days. Inside the computer, the simplified statements are converted automatically into detailed machine instructions. The new procedure, called Commercial Translator, was developed to handle commercial problems such as inventory, payroll, and manufacturing scheduling.

## LESS WEIGHT, FEWER PARTS—LOWER COST

Product cost is usually directly related to the number of manufacturing operations required to make and assemble product parts into a finished unit. In designing its new Falcon economy car, Ford Motor Co. simplified its manufacturing operations by making key parts perform the functions of two or more standard car parts. Here are some examples of the design simplification: Unitized body construction has 200 fewer parts than standard body . . . door frame requires only 2 parts instead of 12 used in 1959 Ford . . . door has 12 parts instead of 21 . . . 6-cylinder engine has 120 fewer parts than a standard six . . . cylinder head and intake manifold are one integral casting . . . gas tank top serves as trunk floor saving 6 pounds in weight . . . garnish molding redesigned and made a part of door stamping. Net result is a small car that is ¾-ton lighter than a standard Ford Fairlane.

## SOLID STATE VACUUM TUBES

Electronic tubes of the future may some day receive their electron flow from semiconductor materials rather than hot, power-consuming cathodes. Westinghouse Electric Corp. scientists have discovered that when sufficient voltage is applied to a tiny crystal of silicon carbide, small spots of light appear on the crystal. Electrons escape from these light-emitting spots producing currents up to one millionth of an ampere. This indicates that the density of the electron flow is quite comparable to that from the cathode of a typical vacuum tube. By replacing an electronic tube cathode with a silicon carbide crystal, a hybrid "transistorized" tube could be developed which would consume a negligible amount of power, produce little heat, and yield electrons instantly and indefinitely when a small voltage is applied across the crystal.

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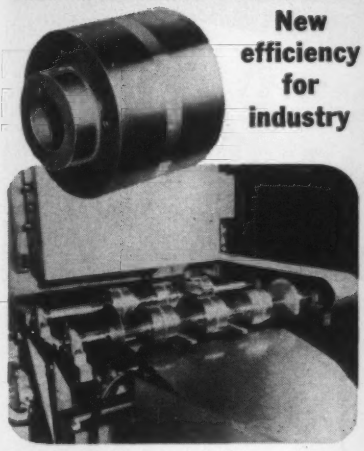

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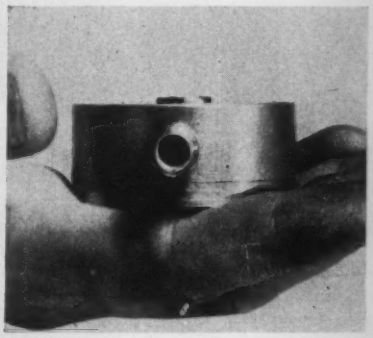
mote location, the input intercoupler reads data on punched cards and activates a teletype transmitter which is linked by wire with a teleprinter in the central location. As data are received by the teleprinter, an output intercoupler automatically activates a card punch which duplicates on cards or ignores the transmitted information, according to programming requirements. By eliminating manual transmission of the data, machine accounting procedures are speeded, and data handling costs can be reduced.



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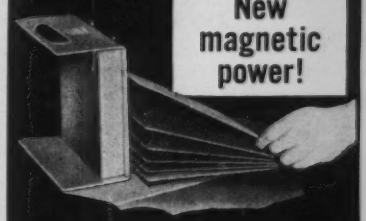
## SPOTLIGHTING PEOPLE

**C. Thorpe Thompson** named director, vice president, and general manager of Sheffield Corp. . . . **James E. Pitman** appointed manager of product planning for point-to-point communication equipment in the Communication Products Dept., General Electric Co. . . . **Philip Hood** named production manager by Epsco Inc. . . . **Dr. Clifford E. Berry** appointed director of engineering in the Analytical & Control Instrument Div., Consolidated Electrodynamics Corp. . . . **William R. Mogg** named general manager of the Spring Div., Crucible Steel Co. of America. . . . **Alva R. Perry Jr.** appointed plant manager, and **L. F. Tree** named production manager of the Military Electronic Computer Div., Burroughs

FOR FANNING HARD-TO-HANDLE SHEETS

New design! New magnetic power!



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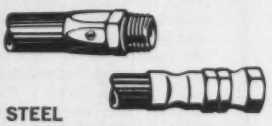
| HIGH PRESSURE | H-35 | H-50 |

Spiral Wire Reinforced

## REUSABLE ENDS



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**STANDARD 2-PC. END**

For fast assembly and positive, leakproof connections. Designed for dependable performance under high pressure. Skive and no-skive.

**CLAMP-TYPE**

For most two-wire braid high-pressure hydraulic hose applications. No skiving of hose or special tools required.

**BARB-TITE ENDS**

Fast, easy push-on, stay-on hose ends for all types of low pressure applications. Sizes ¼" to ¾" I.D. Rugged and durable.

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**PERMANENTLY ATTACHED HOSE ENDS**

Swaged or crimped permanently attached hose ends. Any quantity, any size, any type. ⅛" to 2". For all working pressures.

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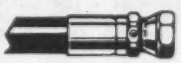

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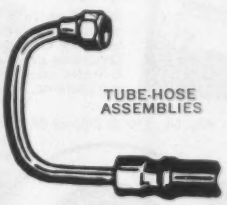


TUBE-HOSE ASSEMBLIES

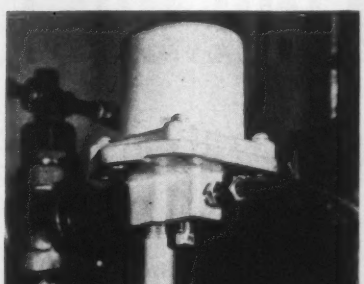
# THE WEATHERHEAD COMPANY

FORT WAYNE DIVISION • Dept.A-10,128 West Washington Blvd.
Fort Wayne, Indiana

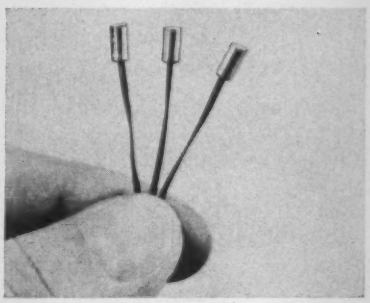


Circle 666 on Page 19

Corp. . . . **Dr. Finn J. Larsen** named vice president in charge of research for Minneapolis-Honeywell Regulator Co. . . . **Louis M. Ballard** appointed president of Micro-Path Inc., subsidiary of Topp Industries Inc. . . . **Frank C. Mullaney,** vice president, appointed general manager, and **Seymour R. Cray** named director of engineering of the Computer Div., Control Data Corp. . . . **Robert G. Hess** appointed president and general manager of the Wright Machinery Co. Div., Sperry Rand Corp. . . . **Byron K. Hartman** named executive vice president and general manager of Syntron Co., subsidiary of Link-Belt Co. . . . **James M. Apple** appointed vice president in charge of manufacturing for Clarke Floor Machine Co. . . . **Donald E. Lake** named production manager of Milwaukee Div., Associated Spring Corp. . . . **Charles B. Lee** joined Control Data Corp. as director of engineering for the Cedar Engineering Div. . . . **Richard E. Bennett** appointed plant manager of Daystrom Instrument Div., Daystrom Inc. . . . **Leon C. Koenig** named vice president of manufacturing for Lindberg Engineering Co. . . . **Joseph T. Colliflower** appointed director of operations for the Maryland Div., Litton Industries. . . . **Edward A. Voss** named manufacturing manager of the Cincinnati Div., Bendix Aviation Corp. . . . **Neil M. Blair** elected vice president and assistant to the president of Intelex Systems Inc., subsidiary of International Telephone and Telegraph Corp. . . . **Heinz Hanau** named director of engineering and research of Western Div., Industrial Tectonics Inc. . . . **E. O. Vetter** elected vice president of Texas Instruments Inc. . . . **James A. Bolton** appointed chief engineer of the Tobacco Div., American Machine & Foundry Co.



AVAILABLE from Thomas A. Edison Industries, McGraw-Edison Co., are resistance pressure detectors that measure and convert gas, fluid, or vapor pressures directly into an electrical resistance. For pressures under 30 psi, a precision capsule is the sensing element. From 30 to 3000 psi, special Bourdon tube elements are used. The pressure sensing element linearly varies the terminal resistance of a low temperature coefficient alloy winding to permit operation over ambient temperatures of 32F to 150F with minimum error. Each alarm pressure can be changed at any time by means of a screwdriver adjustment on the front of the unit.

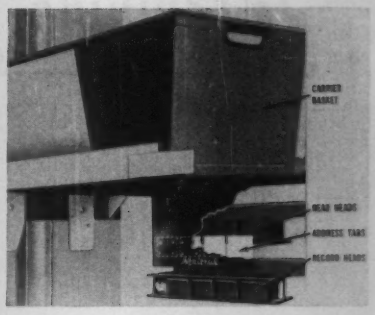


RESISTANCE thermometers for sensing temperature changes from minus 100F to plus 500F are available from Minco Products Inc. The miniature components have a resistance of 470 ohms at 32F which varies at the rate of about 1 ohm per degree F. Units are enclosed in a stainless steel case which is 0.156 inch in diameter and 0.281 inch in length. Lead wires will withstand more than 5 pounds pull, and steel case protects unit against compressive force. Calibration accuracies of plus or minus ¼, ½, and 1.0 per cent are available.

## Establishes Centralized Research And Development Laboratory

EXPANSION of its research and development activities has been announced by Fairbanks, Morse & Co. Plans have been completed to establish a central research and development laboratory at the company's plant in Beloit, Wis.

The new research laboratory will operate independently of all manufacturing activities and will be devoted entirely to research and development for all the corporation's product divisions. Plans include basic research on electronic weighing and control systems, electromechanical devices and machinery,

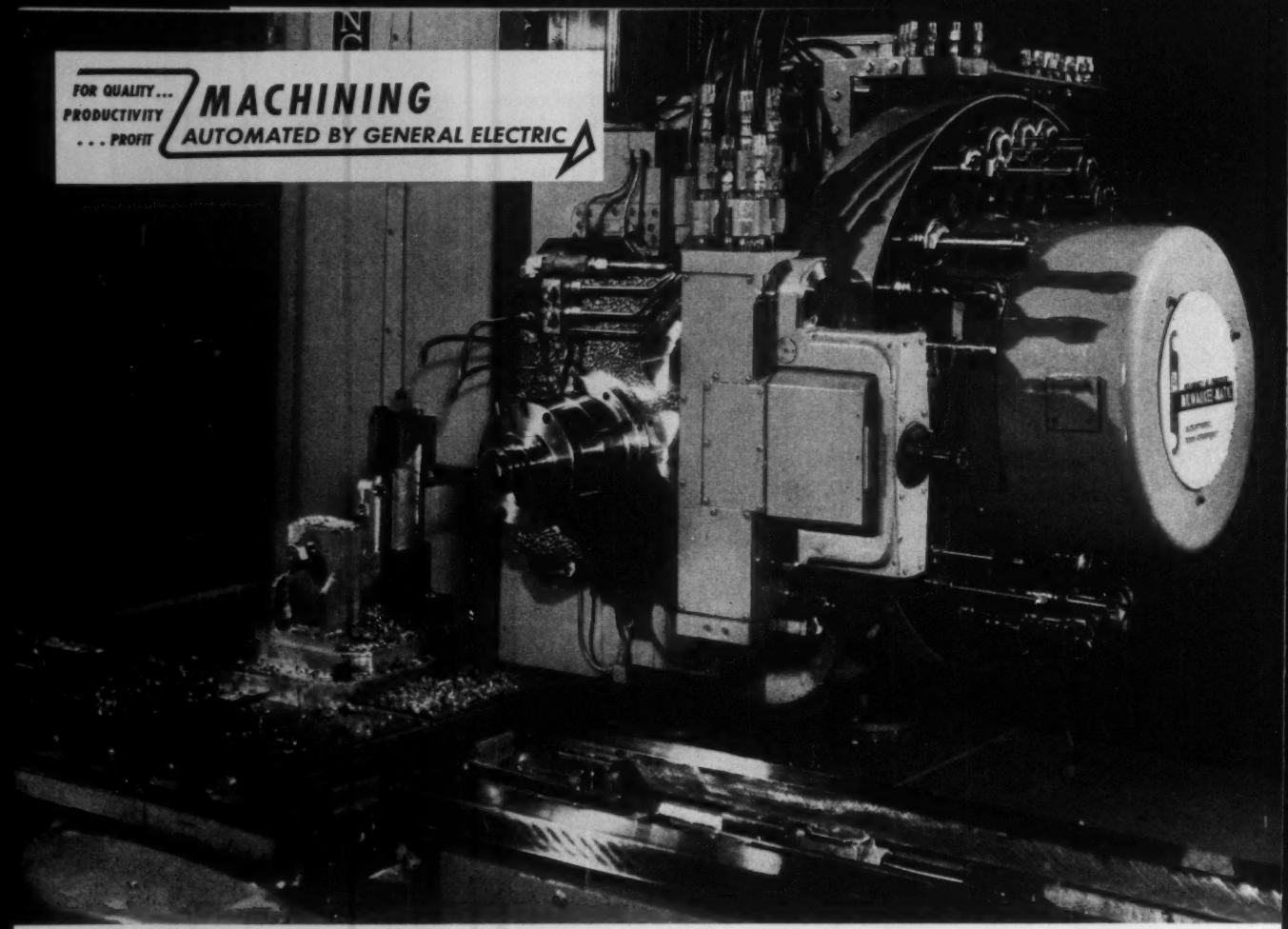



MAGNETIC control system for conveyors, developed by Maico Electronics Inc., provides selective dispatching to as many as 64 different receiving stations. At dispatch station, a pushbutton is provided for each destination on the conveying equipment. When the button is actuated, a magnetic address is impressed on a series of magnetic tabs. Each receiving station contains read heads to scan the tabs as the carrier passes the station. At the correct receiving station, the read heads actuate switching devices to remove the carrier from the conveyor. The unit is shown installed on a vertical conveying system.

and pumping systems with their related products. Initial projects include improvement of existing products, development of new products, and exploration of entirely new fields.

## SPOTLIGHTING PLANTS

**Kearfott Co. Inc.,** subsidiary of General Precision Equipment Corp., has formed a Power Equipment Div. for the design and manufacture of rotating and static power supplies, associated control equipment, and related power and control apparatus. . . . **Industrial Nucleonics Corp.** has moved into new research, engineering, and manufacturing facilities at Columbus, Ohio. . . . **Giddings & Lewis Machine Tool Co.** and **Douglas Fraser & Sons Ltd.** of Arbroath, Scotland, have announced the formation of a British company named Giddings & Lewis-Fraser Ltd. The new company will manufacture Fraser designed automatic machine tools and Giddings & Lewis boring, drilling, and milling machines for the European market. . . . **Telemeter Magnetics Inc.** has purchased 80 per cent of the stock of Digital Instrument Laboratories Inc., manufacturer of electronic products for digital data systems. . . . **American Electronics Co.** has formed a new




# ELIMINATE SPECIAL TOOLING COST

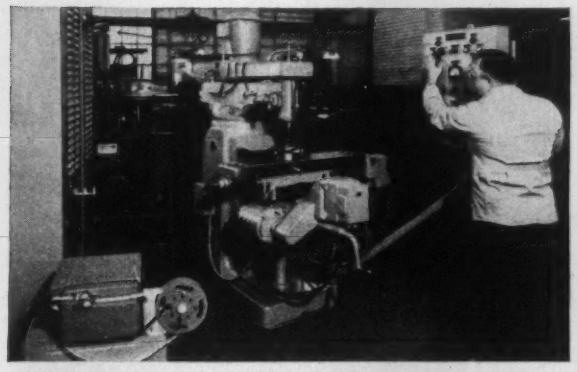
**MARK SERIES NUMERICAL CONTROLS...**

**.....standard, job-proved packages now in use on a wide variety of machines**

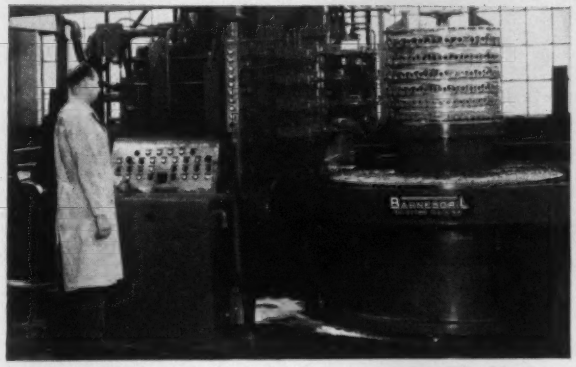
General Electric's Mark series of standard, pre-engineered numerical control packages—with systems for controlling 1 to 5 motions plus machine auxiliary functions — are compiling impressive performance records on scores of machines throughout American industry today.

Machine operation is completely automatic—from punched tape prepared on a standard automatic typewriter. If desired, semi-automatic positioning, useful for prototype work, is obtained with manually set dials on the control station.

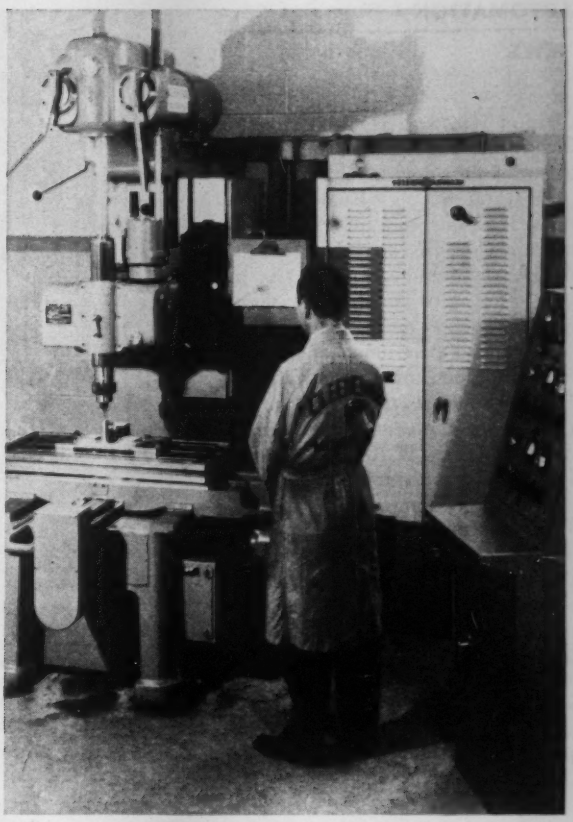
Key components of a typical Mark package are a controller, a punched tape reader, operator's control station, servo drives and position-sensing units.



**60-80% LESS FIXTURE COST** is average for all new parts produced on this general-purpose milling machine. Tooling expense saving for one part totaled $2000.



**TOOLING EXPENSE CUT** from $5000 to less than $100; 248 critical holes spotfaced, drilled, bored, counter bored, and chamfered with no jigs or templates.



**NO JIGS ARE NEEDED** on this G-E controlled layout drilling machine. Tooling cost on one part was reduced from $1350 to $20; $1000 worth of fixtures eliminated on another job.

# with General Electric numerical control

## Eliminate jigs, cut lead times, save costly tool storage space

A key benefit of General Electric numerically controlled machines is the elimination of special tooling cost in application after application. Reports show jigs, templates, and complex fixtures are absolutely unnecessary—being replaced even in the most intricate jobs by simple holding clamps.

What does this mean to you? It's the end of costly tooling . . . it's shorter lead-time cycles . . . less investment in tool storage and maintenance . . . more flexibility in production scheduling.

Many manufacturers find that savings on tooling costs *alone* will pay for their G-E numerically controlled machines. As an example, on a group of six parts, with a variety of operations performed by a multi-purpose tape controlled machine, tooling savings totaled over $10,000 with cost reductions on a single part from $1890 to $260. With less than 100 such parts, the machine is paid for.

In a routine drilling job, $1300 worth of jigs were replaced with a simple $20 holding clamp.

And, another Mark II controlled drill press more than paid for itself in a few weeks. More than 120 different drill jigs—which would have cost $186,000—were *not* made. These savings alone totaled more than 6 times the original investment in the numerically controlled machine!

Join with the more than a hundred manufacturers who are increasing worker productivity, gaining better product quality, and eliminating special tooling cost with G-E numerically controlled machines. See your G-E Apparatus Sales Engineer or machinery builder today. General Electric Co., Specialty Control Dept., Waynesboro, Va. 795-6

*Progress Is Our Most Important Product*

GENERAL ELECTRIC

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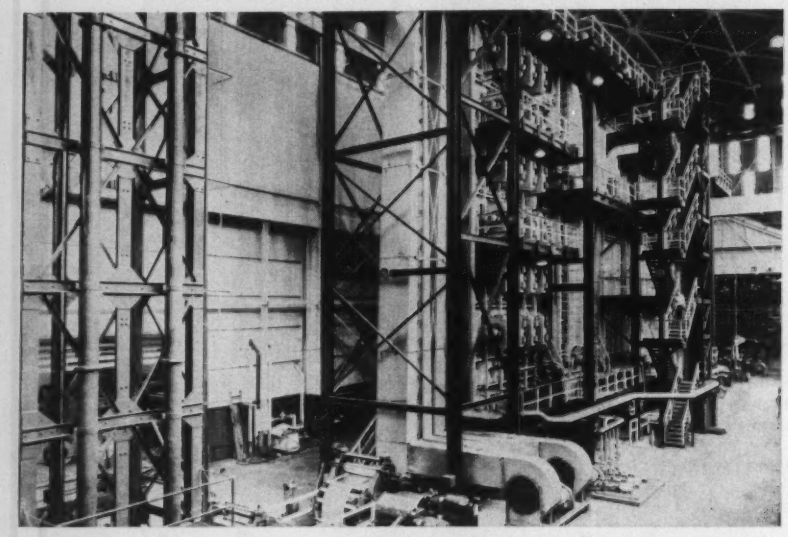
division known as the Monarch Electronics Co. which will specialize in research, design, and development projects. . . . **Feedback Controls Inc.** has moved into a new plant at Natick, Mass. . . . **Integrated Development and Mfg. Co.** has purchased TippTronic Inc., manufacturer of automatic temperature controls and electromechanical overload and monitoring controls. . . . **Leesona Corp.** is the new name for the former Universal Winding Co. of Providence, R. I. . . . **Benson-Lehner Corp.**, manufacturer of data processing equipment, has acquired Data Services Inc. . . . **R. B. Denison Mfg. Co.** has moved into new facilities at Bedford, Ohio. . . . **Raytheon Co.** is planning to construct a 140,000 sq ft manufacturing plant in Lewiston, Maine, for the manufacture of transistors, diodes, and rectifiers. The plant is expected to employ more than 2000 people and is scheduled for completion by the middle of 1960.



CONTINUOUS annealing furnace developed by the Industrial Heating Dept., General Electric Co., has been installed at the Yorkville, Ohio, plant of Wheeling Steel Corp. as part of a $6 million production line for cleaning and annealing electrolytic tinplate. Furnace is 100 feet long and 65 feet high and is designed to process 21,000 tons of strip per month. The fast cooling section of the furnace has 54 jet cooling units which circulate protective atmosphere gas to reduce strip temperature from 900 F to 250 F. The new cooling concept requires only 8 "passes" of the strip in process as contrasted to 30-36 "passes" required in a conventional water-wall system. Accurate temperature control at a range of strip speeds varying from 500 to 1200 feet per minute on the 360-foot cleaning and annealing line provides improved metallurgical qualities in the tinplate.

## MEETINGS AND EVENTS

**Oct. 7-9—**

**American Vacuum Society.** National Symposium on Vacuum Technology to be held at the Sheraton Hotel, Philadelphia. For further information, contact C. B. Willingham, American Vacuum Society, Box 1282, Boston, Mass.

**Oct. 12-14—**

**National Electronics Conference.** Sponsored by the AIEE, IRE, Illinois Institute of Technology, Northwestern University, and the University of Illinois, the conference will be held at Hotel Sherman, Chicago. For further information, contact Hal Bergen, 185 N. Wabash Ave., Chicago 1, Ill.

**Oct. 12-14—**

**Systems & Procedures Association of America.** International Systems Meeting to be held at the Royal York Hotel, Toronto, Ontario, Canada. Additional information may be obtained from Dar E. Tisdale, National Headquarters SPA, 4463 Penobscot Bldg., Detroit 26, Mich.

**Oct. 19-21—**

**American Institute of Electrical Engineers.** 11th annual Machine Tool Conference to be held at the Sheraton-Cleveland Hotel, Cleveland. Additional information is available from E. F. Kimball, Clark Controller Co., 1146 E. 152nd St., Cleveland 10, Ohio.

**Oct. 20-22—**

**Sixth Annual Conference on Lubrication.** Jointly sponsored by the American Society of Lubrication Engineers and the American Society of Mechanical Engineers, conference will be held at the Sheraton-McAlpin Hotel, New York. For further information, contact ASLE headquarters, 5 N. Wabash Ave., Chicago 2, Ill.

**Oct. 22-23—**

**National Conference on Industrial Hydraulics.** Fifteenth annual meeting sponsored by the Graduate School of Illinois Institute of Technology and the Armour Research Foundation will be held at the Sherman Hotel, Chicago. Additional information may be obtained from R. D. Meade, Illinois Institute of Technology, 3300 Federal St., Chicago 16, Ill.

**Oct. 28-29—**

**Computer Applications Symposium.** Sponsored by Armour Research Foundation of Illinois Institute of Technology, symposium will be held at the Morrison Hotel, Chicago. Additional information is available from M. J. Jans, Armour Research Foundation, 10 W. 35th St., Chicago 16, Ill.

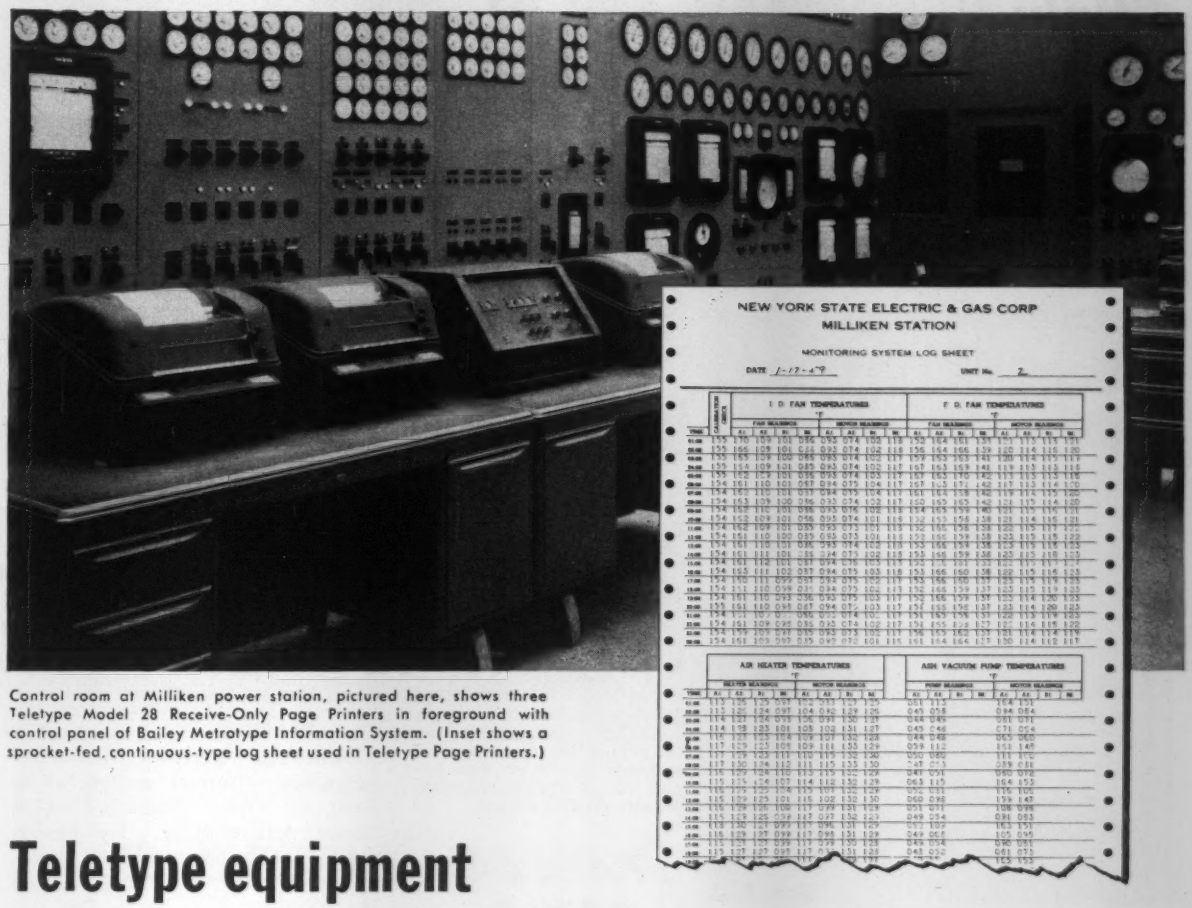
**Nov. 2-6—**

**National Metal Exposition and Congress.** Exposition to be held at the International Amphitheatre, Chicago, and technical meetings to be held at Hotel Sherman by the American Society for Metals, Society for Nondestructive Testing, and the American Institute of Mining, Metallurgical, & Petroleum Engineers. Additional information is available from the American Society for Metals, Route 87, Novelty, Ohio.

**Nov. 4-6—**

**National Automatic Control Conference.** Sponsored by the Institute of Radio Engineers Professional Group on Automatic Control with official participation by the AIEE, ISA, and the IRE Professional Group on Industrial Electronics, meeting will be held at the Sheraton Hotel, Dallas. For further information

*Automatic read-out . . .*




Control room at Milliken power station, pictured here, shows three Teletype Model 28 Receive-Only Page Printers in foreground with control panel of Bailey Metrotype Information System. (Inset shows a sprocket-fed, continuous-type log sheet used in Teletype Page Printers.)

# Teletype equipment monitors and records power station performance

New Model 28 Teletype Page Printers and Tape Punch equipment provide a continuous, dependable data processing facility for evaluating power station performance. This Teletype communication equipment is part of a Bailey Meter Company Metrotype® Information System installed recently at the Milliken power station of the New York State Electric & Gas Corporation, near Ithaca, New York.

This installation consists of two data systems:

**1. A Monitoring System** that continuously scans a total of 282 variables—temperatures of fan, motor and pump bearings; pressures of water and oil pumps, etc. Whenever readings exceed prescribed limits, system immediately reads and prints complete digital data of off-normal operation. In addition, complete readings are printed hourly.

**2. A Performance System** that scans 66 points once every hour, measures generator output, main steam flow, feedwater flow, temperatures, etc. All factors required to evaluate the station's performance are logged on the Teletype Printers. A Teletype Tape Punch also produces a perforated tape for IDP.

Robert Darke, Systems Division Manager, Bailey Meter, says, "Teletype equipment was chosen for this installation because of its flexibility and proven reliability. Design is simple and trouble-free, and the units are manufactured specifically for round-the-clock rather than intermittent service."

Teletype equipment will handle data for virtually any purpose in any industry. Signals may be serial or multi-wire. Signal medium may be local electrical circuit, telegraph or telephone circuit, or radio.

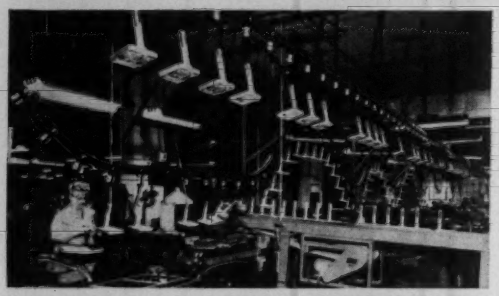
Why not find out how Teletype equipment can fit into your systems plan? Please write: Teletype Corporation, Dept. 21K, 4100 Fullerton Ave., Chicago 39, Illinois.

**TELETYPE®**
**CORPORATION**
SUBSIDIARY OF *Western Electric Company* INC.


Circle 668 on Page 19

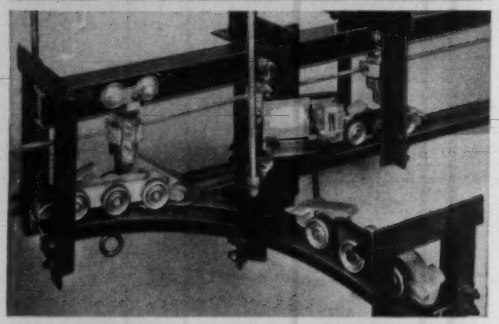
# *Only* BUSCHMAN *has it!*

## 3 Cable Conveyors
### made from standard stock parts



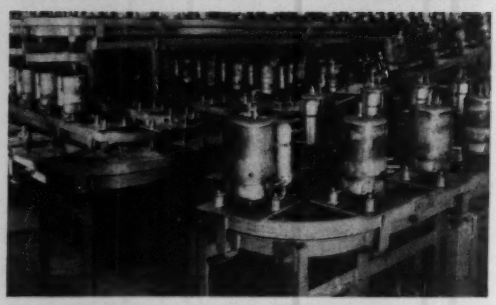
### *OVERHEAD TROLLEY*

Carries light to medium weight loads up, down and around thru all operations at convenient heights. Patented Bush-Lock Cable is practically continuous, furnished in 100 ft. lengths, has least wear of any type power transmission element. Rotary-floating-action Trolley. Requires minimum lubrication.



### *POWER-FREE*

Triple T Power-Free Cable Conveyor is a low cost space saver coming into wide use. Top tee rail is powered by Bush-Lock Overhead Trolley and dual rails carry load. Automatically transports products and parts to free lines for special operations and returns them to main line as required, using ingeniously designed switches.



### *TABLE-CABLE*

Ideal for handling a variety of products through assembly at worktable heights. 4-wheel carriers run on angle tracks carrying light to medium weight loads on pallets or fixtures. Two-level Table-Cable handles compressors in electrical manufacturing plant. It can handle your product at a saving.

Whatever your handling problem, see for yourself. These versatile cable conveyors make low-cost production a reality. Pay for themselves out of actual savings. Operate year after year with no down time, no maintenance except lubrication. And selected as standard in thousands of plants for its superior design this compact, inexpensive, cost-cutting conveyor will do a real job for you. Can be quickly assembled to your exact requirements from regularly stocked parts.

***The same basic components in these 3 types.***

***Write Today for literature***

*Every Way Better*

E W B

**THE E. W. BUSCHMAN CO.**

4551 Clifton Avenue, Cincinnati 32, Ohio

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CONVEYORS FOR EVERY INDUSTRY


contact M. L. Barnett, 1095-C Magellan Circle, Dallas 18, Tex.

Nov. 9-12—

**National Electrical Manufacturers Association.** Annual meeting to be held at the Traymore Hotel, Atlantic City. Additional information is available from Russell Gingles, NEMA, 155 E. 44th St., New York 17, N. Y.

Nov. 11-13—

**Operations Research Society of America.** Sixteenth national meeting to be held at the Huntington-Sheraton Hotel, Pasadena, Calif. For further information, Sidney I. Firstman, Rand Corp., 1700 Main St., Santa Monica, Calif.

Nov. 17-20—

**Packaging Machinery Manufacturers Institute.** National exposition to be held at the Coliseum, New York. Additional information is available from Hanson & Shea Inc., One Gateway Center, Pittsburgh 22, Pa.

Nov. 29-Dec. 4—

**American Society of Mechanical Engineers.** Annual meeting to be held at the Chalfonte-Haddon Hotel, Atlantic City. For further information contact ASME headquarters, 29 W. 39th St., New York 18, N. Y.

Nov. 30-Dec. 4—

**Exposition of Chemical Industries.** 27th biennial exposition to be held at the Coliseum, New York. Additional information is available from the International Exposition Co., 480 Lexington Ave., New York 17, N. Y.

*"We didn't want to overlook any quality angles."*



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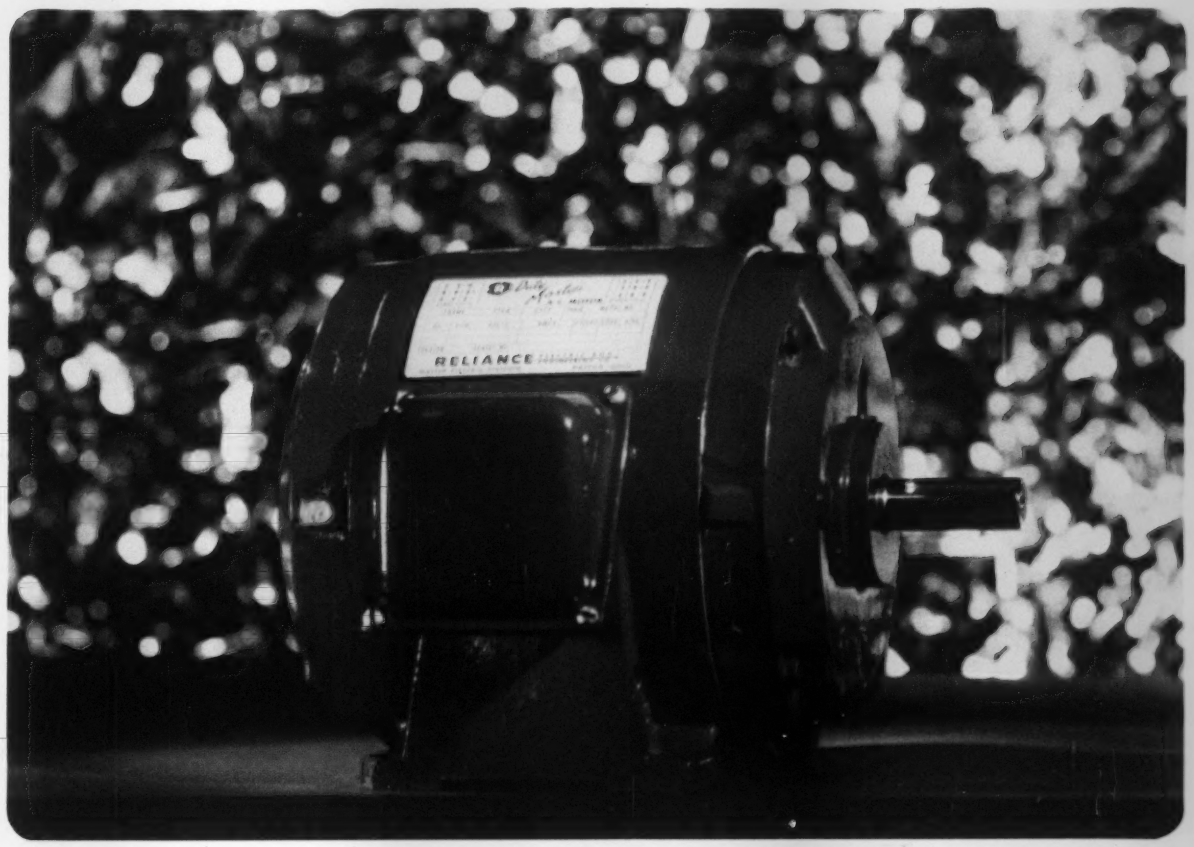
Circle 670 on Page 19→




# *a brand new A-c. motor*

# the DUTY MASTER

A completely new motor produced by The Reliance Electric and Engineering Company and its Master Electric Division. Duty Master offers built-in protection, simplified lubrication and improved performance.

Duty Master shows that all motors are not alike, see next page for details.

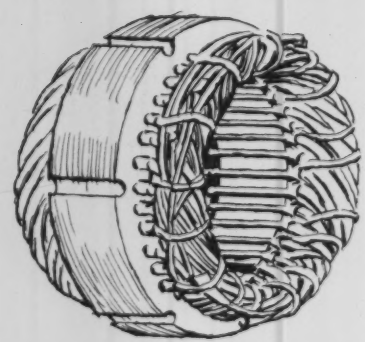
Available now from stock, 1 thru 250 hp. in all enclosures.

**RELIANCE** : **MASTER**

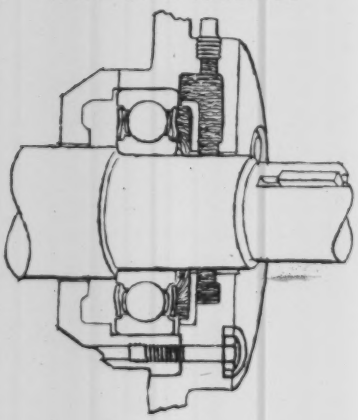
ELECTRIC AND ENGINEERING COMPANY : ELECTRIC COMPANY DIVISION

Earl C. Barnes, Chief Engineer

*"Duty Master is built to last from the inside out."*



PROTECTED WINDINGS



METERMATIC LUBRICATION

"Built-in protection was the aim in designing the Duty Master. From the steel core to the cast iron frame, everything possible has been done to insure long life under severe operating conditions.

"The insulation is moisture-proof and acid-resistant. Windings are thoroughly dried, pre-heated and impregnated with multiple dips in thermosetting varnish, and finally given a sealing coat of finishing enamel.

" 'Metermatic' bearing lubrication fits any plant lubrication schedule. Motor bearings are lubricated constantly from a large reservoir. A metering plate feeds measured amounts of grease to the bearing as required. The reservoir and automatic grease relief along the shaft make it impossible to over or under grease the Duty Master.

"Whatever your requirements, Duty Master gives you extra built-in protection and longer motor life." *Earl C. Barnes*

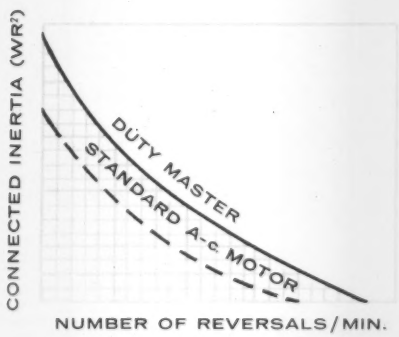
**RELIANCE** — **Duty Master**

**A-C. MOTOR**

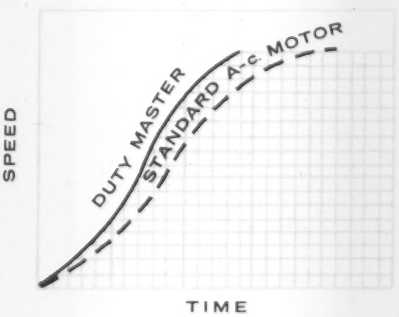
Dr. C. G. Veinott, Chief A-c. Design Engineer

*"Duty Master's electrical design provides improved operating characteristics."*

**REVERSAL**




**ACCELERATION**

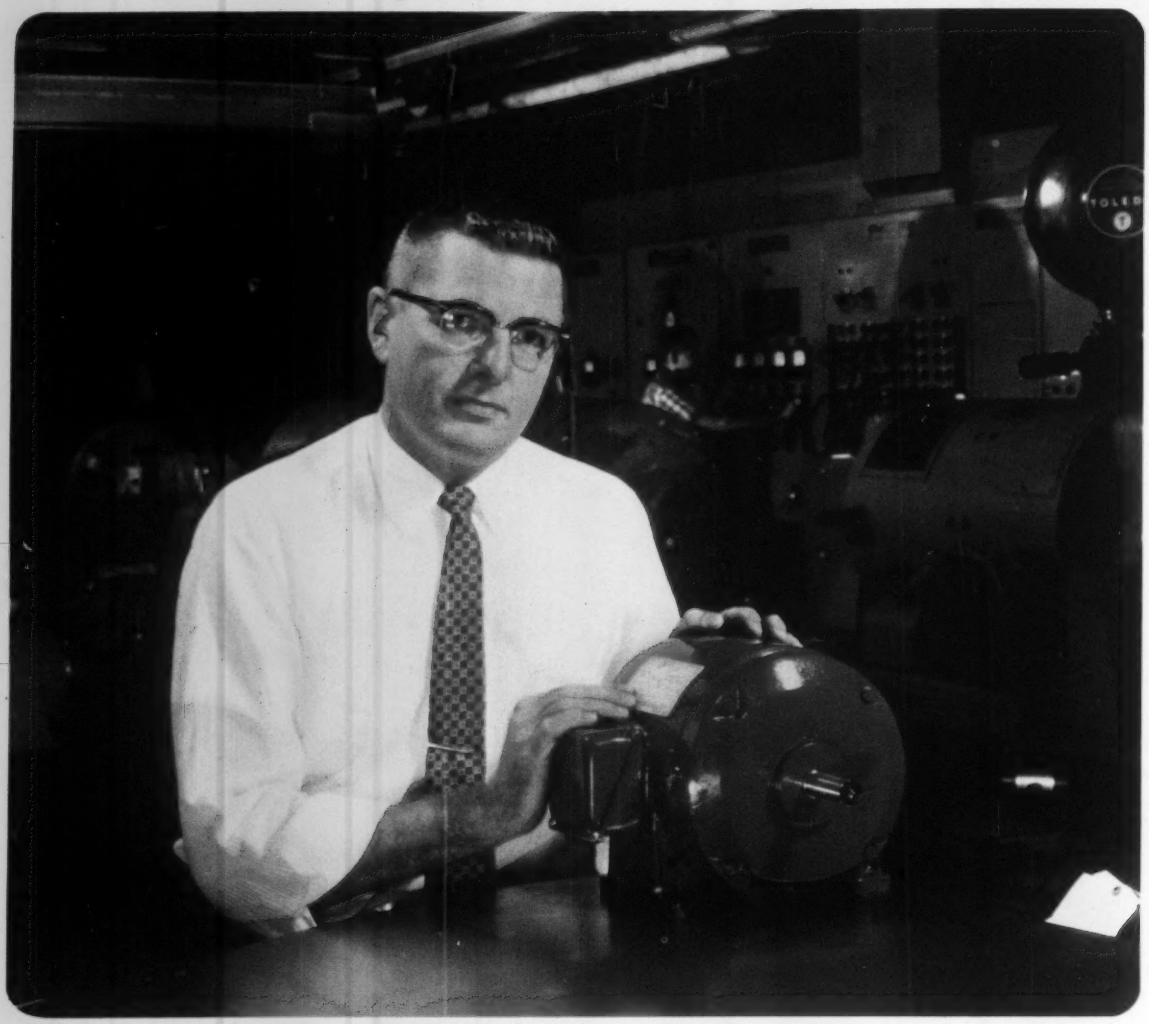



"The electrical design of the Duty Master was thoroughly analyzed through the use of digital computors. The purpose of this specialized work was to produce a motor with maximum operating characteristics and maximum efficiency.

"The most visible result of the extensive computor program is the new low inertia rotor. The rotor, like the rest of the Duty Master, takes advantage of new materials and techniques. This rotor, plus better ventilation and other refinements, gives a definite improvement in acceleration, reversals and start-stop performance.

"This is just one example of many mechanical and electrical design changes that make Duty Master a new motor, not just a face lifting." *Dr. C. G. Veinott*

**RELIANCE** — **Duty Master**
**A-C. MOTOR**



John Walker, Manufacturing Manager

*"Manufacturing quality and deliveries are emphasized for Duty Master."*

"A motor design is no better than the finished product. That is why we lay particular emphasis on experienced plant people and top quality materials.

"New automatic winders, annealing furnaces, conveyor systems, turning and welding equipment are another part of the quality picture. Equally important is proper scheduling to deliver the motor on time. The new Duty Master is not only an exceptionally good motor, it is an available motor, ready for delivery without unwarranted delay." *John Walker*

**Duty Master Motors, 1 thru 250 hp. in all enclosures, are ready for immediate off the shelf shipment from Reliance Distribution Centers and Warehouses across the country. Contact your Reliance Sales Engineer for complete information, or write today for Bulletin No. B-2106.**

**RELIANCE** ELECTRIC AND ENGINEERING CO.

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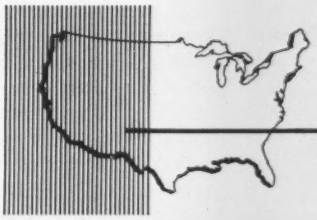
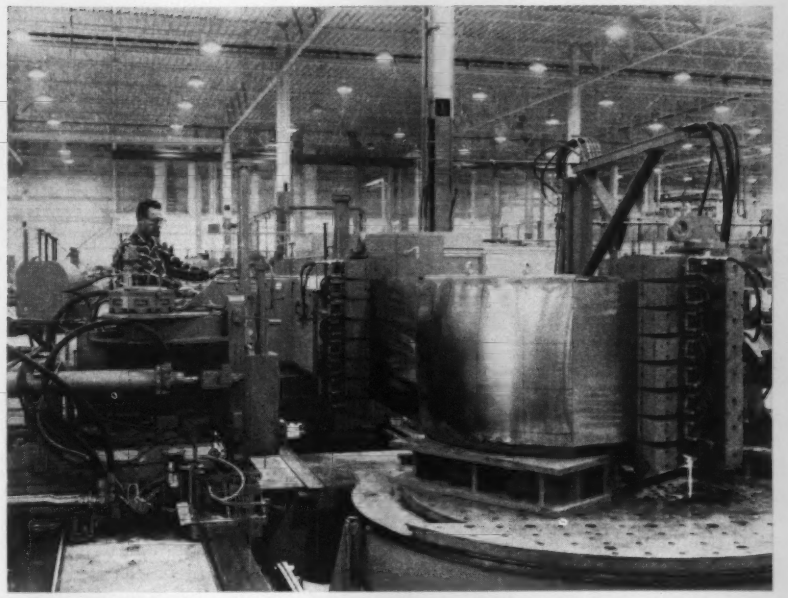


# western trends

BY PATT PATTERSON
Los Angeles, Calif.



Radial draw former at Convair (Astronautics), Div. of General Dynamics Corp., stretches a sheet of thin stainless steel around a die to form a section of skin for the Atlas ICBM. An automatic electronic technique is used to monitor the stretching by measuring physical changes in the metal being stretched. Single sections are produced that were formerly manufactured by multiple part welding. In some applications, a compression shoe is attached to the cylinder-driven holder in left foreground to press the metal against the die to form special contours.

## Production Refinements

AS METALWORKING and fabricating become more sophisticated, Western manufacturers are investing in equipment which makes each process fully or partially automatic. This trend has been brought about in the modern aircraft and missile industry by the necessity for the close tolerances and detailed, precise machining that a human operator is unable to perform.

In addition to the more conventional methods of stamping or chemical milling skins for missiles, for example, Convair (Astronautics), a division of General Dynamics Corp., produces contoured metal parts for the Atlas ICBM by stretching. The Cyril Bath radial stretch former is the largest in the United States to use a hydraulically driven turntable and automatic controls. Tension control is established by electronic measurement of actual physical changes which take place in the part during forming.

Locked in hydraulically operated jaws of the stretch former, 20-foot sheets of stainless steel are stretched as much as 18 inches. The metal, kept in controlled tension while the table revolves, is drawn over the outer surface of a table-mounted die. At the same time, a compression shoe presses the metal against the die face. This shoe is shaped to mate precisely with the die profile.

The electronic system automatically controls tension throughout the forming cycle. A recorder provides a graphic record of stresses for later reference. By use of completely automatic stretching control, the skin sections are drawn to the precise limits required to meet the close tolerances of the Atlas. The 93-ton machine has reduced waste normally associated with cutting-type machines, and has made possible production of metal shapes and parts that formerly called for welding several pieces together.

### Tape Controlled Welding

Another San Diego aircraft company, Ryan, producing fuselage sections for Boeing's giant KC-135 Air Force jet tanker-transport, has automated what was formerly a production bottleneck. The new process involves the replacement of slow, laborious riveting with high speed spotwelding, tape controlled for precise positioning.

The skin sections to be welded are double contoured, which makes automatic positioning a necessity. Ryan, in a joint development program with General Riveters Inc., produced an electronically operated positioning table to guide the large panels through the welding machines. The spotwelders themselves are the largest built for certified structural welding.

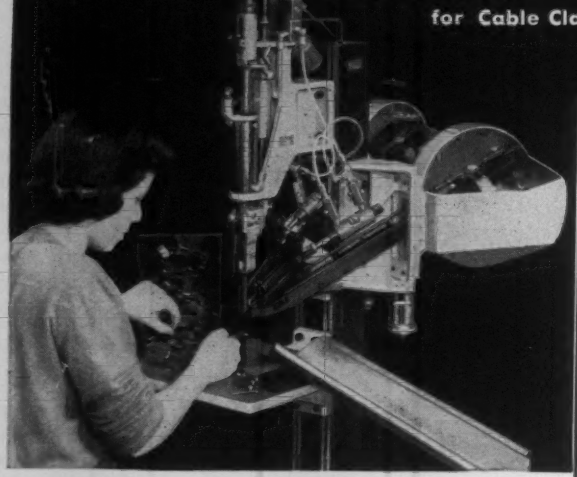
A positioning table employs an electronic system which senses and levels the part so the skin is perpendicular to the welding tips for each weld. A sensor head is mounted on the welder electrode to control skin positioning.

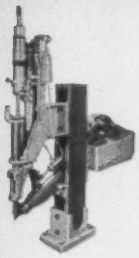
The positioning table has a trunnion mechanism and a horizontal drive mechanism for inserting the skin section into the jaws of the spotwelder. The table automatically raises the skin to be free of contact with the lower electrode, runs it into the welder jaws, and automatically lowers the section onto the bottom electrode for welding. The carriage is manually controlled for locating the first weld, and for loading and unloading. All other operations are tape controlled.

A greater number of manufacturers are moving to tape control,

# DIXON *Auto-Torque Driver*

Speeds Assembly and Screw Driving for Cable Clamp





The standard *Auto-Torque* Driver as furnished for use as a fully automatic station. Also built as a pedestal model with foot treadle for starting the cycle.

**2000 Hand-Fed Assemblies Per Hour—Two Parts Placed With A Single Chuck**

The machine shown above, which is tooled for the assembly and screw-driving work for a three-part cable clamp, is a good example of the adaptability and versatility of the DIXON *Auto-Torque* Driver (Automatic Screw Driver). Two feeders place the Phillips Head Screw and one part of the clamp in a *single* chuck with positive action. The self-tapping screw is then driven to a predetermined depth into the base part, which has been placed in the fixture by the operator.

**Exclusive Design Features Provide Accurate, Dependable Operation**

Many design features contribute to the over-all efficiency and dependable operation of the DIXON *Auto-Torque* Driver, which is furnished in standard models or as special arrangements. Chief among these is the positive-acting feeder with ram-action placement of the part into the chuck. This feeder is compact, with a straight track and an orienting block to avoid jams, assuring proper entry of the screw or nut into the feed track.

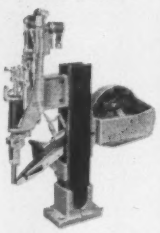
A built-in sensing mechanism operates automatically to stop the machine when a screw is missing or only partially driven. This assures quality control and is essential for automatic installations. The sensing feature is also of great value when driving a screw or nut to a predetermined depth without torque requirement.

Another important feature is the *Adjustable-Torque* Clutch which can be furnished in two torque ranges. It represents a new high in accuracy, ease of adjustment, and smooth operation. Accuracy is within 5% of the torque setting and it can be furnished for closer tolerances for special applications. It cannot overdrive the screws.

***Ask for Descriptive Matter or Special Information***

Complete information on the standard DIXON *Auto-Torque* Driver is given in Bulletin SD-B1. This and bulletins on other units are available on request. Tell us your requirements.

**OTHER DIXON EQUIPMENT**



*Auto-Positioner* for small parts assembly. Furnished as automatic station or as pedestal model.

Positive-Acting Piece Parts Feeder for delivering small parts to assembly machines, presses, etc.

Parts Escapement for releasing parts singly or in multiples.

DIXON **DIXON AUTOMATIC TOOL, INC.**

2312 - 23RD AVENUE • ROCKFORD, ILLINOIS

EQUIPMENT FOR AUTOMATIC PARTS HANDLING AND ASSEMBLY


both punched and magnetic, of their equipment. The tape reduces rejects due to machining errors and, in many cases, even provides safety checks and testing procedures to determine if tools and materials are suitable for the next operation. In addition, tape equipment is providing automatic recording of complex operations for engineering or instrumentation reference.

Ampex Corp., one of the largest manufacturers of magnetic tape equipment, has provided tape control equipment for a number of equipment manufacturers, including Giddings & Lewis and others.

At the Martin Co. in Denver, Colo., the U. S. Air Force Titan missile is produced with the aid of numerically controlled milling machines. This numerical control is provided by magnetic tape.

At Rohr Aircraft, in Chula Vista, Calif., complicated wing parts for the Boeing KC-135 tanker are machined on a tape controlled profiler.

Ampex units are also used in automatically recording data from instrumentation and tests for later evaluation. At Holloman AFB in New Mexico, units are used in a digital data processing system to provide flight simulation tests.

Another simulation setup is at the Army's Talos unit at the White Sands Missile Range in New Mexico. There the instrumentation recorders simulate enemy attacks and train operating personnel.

In the field of vibration testing, tape recorders are often used in a prototype missile to create the various environmental force effects on the structure in flight. These recordings of vibration and shock are fed through special environmental testing equipment such as the Ling Electronics complex wave test installation at Jet Propulsion Laboratory (Cal Tech), which is a part of the National Aeronautics and Space Administration effort to implement space probes. By reproducing the forces through electromechanical shakers, the components for use in missiles, and the entire structure itself, can be tested. The first Explorer was tested on this equipment, and recorded flight data were used to test others in the series. At the Ft. Worth plant of Convair, Div. of General Dynamics Corp., B-58 components are subjected to tests that equal in-flight effects.

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Extreme accuracy — within ¼ degree • High frequency response — three times greater than obtained with conventional electrical equipment • Self-contained — simple and easy to install, operate and maintain • Complete versatility — readily adaptable to all phases of industry • Operates on 115 V, 60 cycle power.

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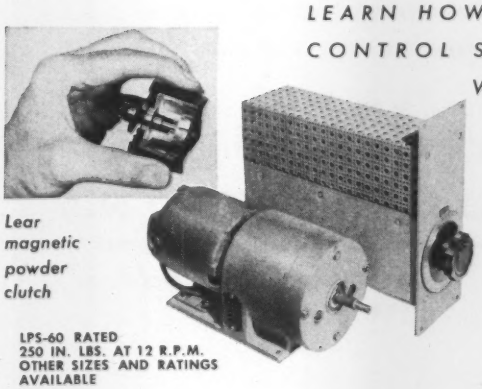

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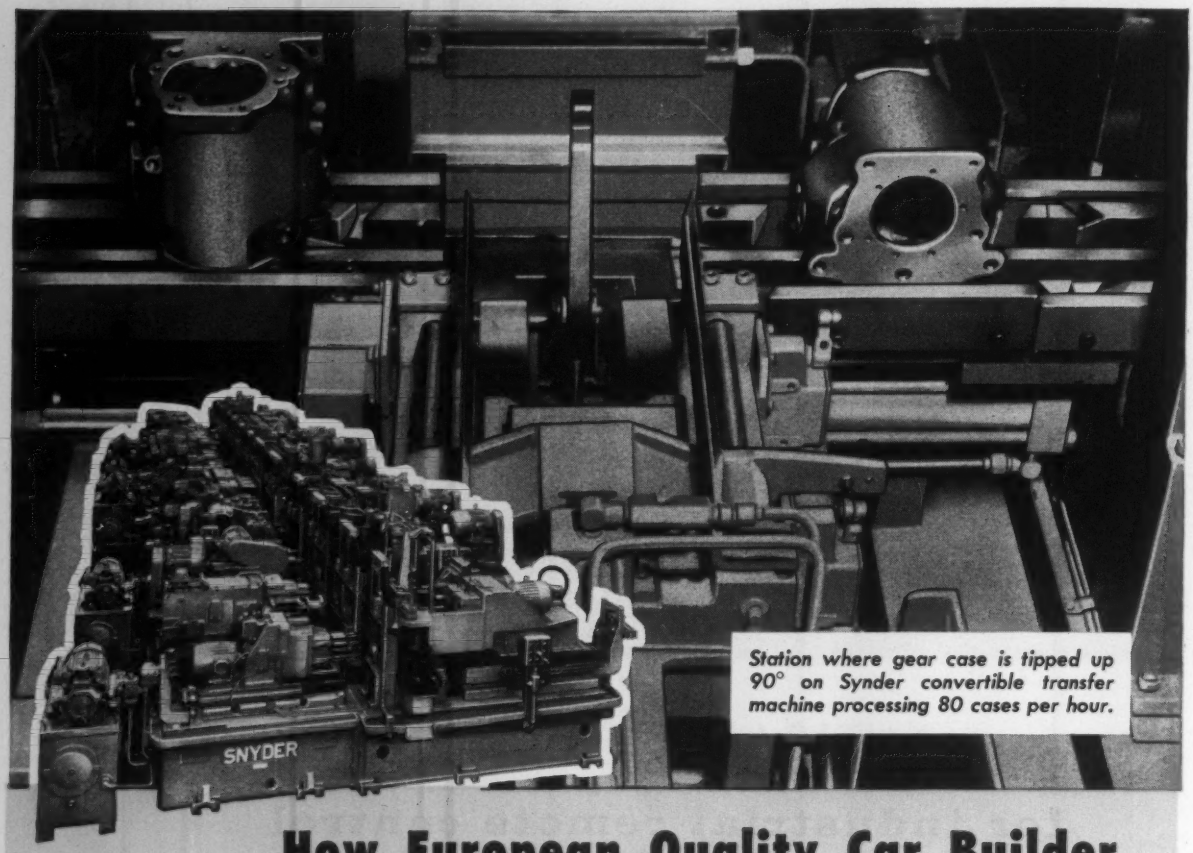
Circle 672 on Page 19




*Station where gear case is tipped up 90° on Synder convertible transfer machine processing 80 cases per hour.*

# How European Quality Car Builder Snyderizes for the Soaring Sixties

This new 53-station transfer machine combines special purpose efficiency with high convertibility for later changes. Part orienting devices enable Snyder to utilize standard horizontal way-type units to drill, spotface, chamfer, ream, line-ream, mill and bore this cast iron standard gear transmission case on all faces. The cases are turned 90° at the thirteenth station and tipped up 90° at the thirty-eighth station, which eliminates vertical machining units. The part is specifically located on faces not subject to future design changes, thus reducing future capital expenditure.

* * *

Let us show *you* how to SNYDERIZE FOR THE SOARING SIXTIES for more efficient parts handling, gaging, assembly and machining. Send or phone for new brochure with resume of Snyder machines engineered for profit improvement.

**Standard Features of Snyder Machines**

1. SNYDER SELF-CONTAINED UNITS and other units equipped with hardened and ground steel ways.
2. Threading and tap heads equipped with individual lead-screw spindles.
3. Minimum downtime for tool changes because spindles are arranged for pre-set cutting tools.
4. Automatic lubrication.
5. J.I.C. Standards throughout.
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7. Panels equipped with SNYDER CIRCUIT SLEUTH.

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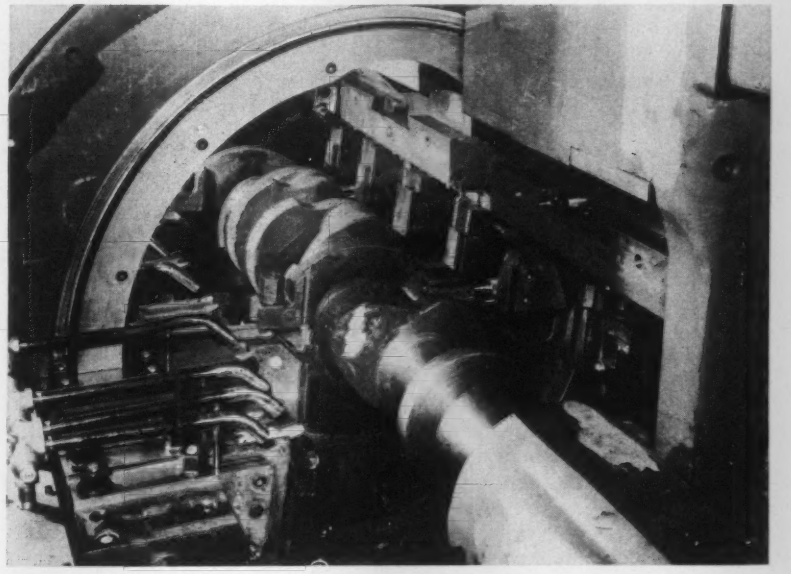
By JAMES C. KEEBLER Managing Editor



Special mounting plate for cutting tools simplifies tool changes when roughing different size cranks at Caterpillar. Rugged gang tools enable the Wickes automatic to cheek, turn, and fillet all bearings, flanges, and stub ends of a crankshaft simultaneously.

# Automating Little Lots

THERE are lots of little lots that can use a little automating. Those of us that like to think we're helping to teach the techniques of automation, to those who improve their own knowledge by reading technical publications and by being practitioners of the art, have recognized that many principles of automation have broad application.

**Balance the Curriculum**

In order to put forth this educational information on a broad enough base, and not overlook important categories of study, we've taken to classifying written material. When the keen student of production processes starts to set up classifications for subdivisions of the broad subject of automation, he soon discovers that there are probably more ways to cut up the subject than there are ways to skin a cat.

**Define the Term**

For better or for worse the managing editor of AUTOMATION magazine one day announced to the staff that one of the distinguishing points of interest should be "lot size." Some automatic production techniques are best suited for large lots. Some are peculiarly suited for job lots, and other concepts of automation apply equally well to both large and small lots. This one-two-three approach that says the item in question is either for big, or little, or both seemed straightforward enough until the thinking men came back with the question: "What are the distinguishing characteristics of a *job lot?*"

Having tried (so far in vain) to assign definitive words to the term, it can be said without fear of successful contradiction that it's easier to cite an example than it is to write an ironclad definition of *job lot.* This effort to define the term is spurred by the recognition that effective communication requires mutual understanding of such matters.

A job lot may or may not involve considerable setup time to prepare the equipment for the parts to be manufactured. It may or may not have fewer than 1000, or fewer than 100, or fewer than 10 parts in the lot. It might be special to the extent that such parts were never made before nor is a repeat order contemplated. It might not. It may or may not be a small component quantity of a large order with similar quantities of other orders interspersed in the sequence of consecutive parts being processed over the equipment. It may or may not involve the use of standard or special machines.

A job lot is probably a lot of parts that is fewer in number than is considered normal for: 1. This particular industry. 2. Or this particular company. 3. Or this shop or department or machine. 4. Or this particular product classification. Furthermore, in this text job lot is construed to be synonymous with "small lot, little lot, and low quantity." It means what most people connected with manufacturing know darn well it means.

That takes care of that until some guy in a continuous production rubber fabricating plant answers a questionnaire in which he's supposed to say what lot size he's involved with and he replies, "Not applicable—have continuous production—no lots."

**Important Reminder**

Now that two out of three are questionable it's time to get more basic than the present terms and say that the purpose of the lot size identification is to constantly remind us that this automation is not just for the "make 'em by the million boys," but that the little lot producers need, and have developed, automatic manufacturing operations

that can handle their type of problem.

This is an important reminder. Clearly, where terminology is found lacking, the populace goes by reputation. Because the auto industry counts total quantity of market with seven significant figures they are reputed to make 'em by the millions. Many observers conclude that if the fathers of automation have that kind of production quantities then that's the kind that automation is meant for. This assumption about automation is as wrong as this assumption about automakers.

**For Instance**

Delco-Remy division of General Motors competes for the automotive starter motor business on all quantity levels. Not only do they make large quantities of standards, they also build small quantities of similar but special motors for use on engines produced on a limited basis. This mix requires manufacture of 22 different cast iron commutator end frames. Production needs range from a few hundred a year to thousands per month.

Drilling and reaming of these parts requires equipment to handle differences in hole size and location on the different parts. These holes were formerly produced on an assortment of equipment depending upon lot size. Included were gang drills, adjustable spindle machines, special machines, and various combinations of all three.

Now these jobs are being run on a standard 24 spindle Natco drill specially tooled to do them all. To facilitate quick change of cutting tools and simplify setup of a different part, the machine is equipped with a slip spindle plate beneath the geared head. This plate is bored for 44 spindle locations. Spindles in this plate are connected with the drivers in the head by shafts with universal joints on each end. Setup requires that the detachable lower universal joints be connected to the appropriate spindles, that the proper cutting tools be inserted in the proper spindles, and that spindle speeds be changed when necessary.

Various end frame castings, all of which are similar in size, are accommodated by one six-position fixture mounted on an 18-inch diameter hydraulically operated index table.

Automatic feed cycle of this machine simply involves hydraulically raising and lowering the table so that the workpiece comes in contact with the cutting tools. This action is interlocked with the index action and completes the automatic cycle.

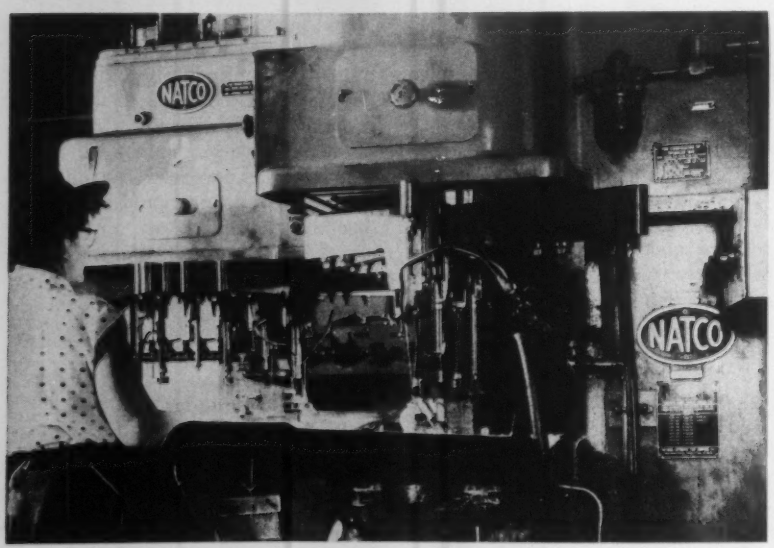
Although this technique involves manual loading and unloading of the fixture, it can be seen that the flexibility of this equipment, specially tooled for quick changeover, makes it a big step in automatic operations as compared with gang drilling.

Another case study brings home this point more clearly. Zenith Carburetor division of Bendix retired 170 single spindle drilling machines when it switched to ten multiple spindle Natcos. Gang drills use gangs of guys or gals. Formerly a carburetor cover was drilled by five operators using ten drill press spindles with ten jigs. A fuel bowl took two operators, four spindles and four jigs. New setups each use 2 multiple spindle drills and a single operator. Cost savings are 81 per cent on the cover and 70 per cent on the fuel bowl. Lot sizes range from 300 to 10,000.

This installation doesn't use slip spindle plates, but provides layout charts to assist in setup of drill spindle brackets under the lower universal joints. Some spindle brackets are equipped with pressure pads to hold parts firmly in fixtures as the worktable comes up. This eliminates manual clamping and decreases loading and unloading time.

Simplicity of setup changeover from one part to another is a requirement in automating little lots. Numerical control of a positioning table under a three-headed Natco permits machining of fuel pump mounting holes in several positions on various diesel engine castings.

Special tooling mounting plates on a Wickes crankshaft lathe enable Caterpillar Tractor Co. to process crankshafts in 11 sizes on one machine.

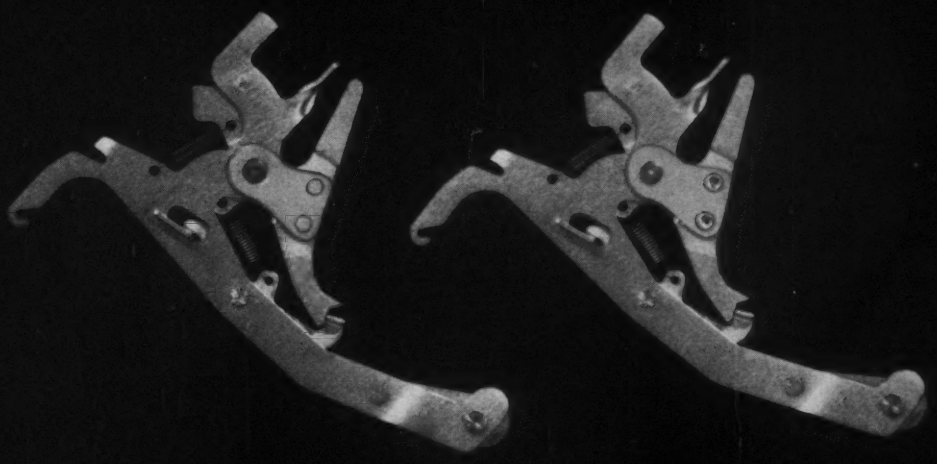



These two multispindle Natcos machine diecast covers and fuel bowls at Zenith Carburetor. Operations on the cover are accomplished at three table positions (left). After each cycle, operator removes one finished part, transfers half-finished part, and loads a new one. Fuel bowls are finished on the right-hand machine; here two positions are used, one for each face.

**Keenly Aware**

Automating automakers have a keen awareness that there is a potential saving to be claimed by using automatic operations, regardless of lot size. Small lots generally require that the equipment be flexible enough to be used for other parts. To achieve savings, automatic equipment used for this type of production must be simple to set up, or the cost of changeover will exceed the cost of production using more manual means. Numerical controls and ingenious tooling arrangements provide keys to the quick-change chest of treasure.

# "The difference is almost invisible



# ...but it saved us nearly $20,000"

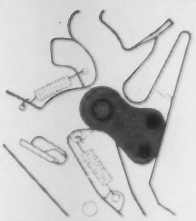
Royal McBee had been using solid rivets and a staking machine to put together an assembly for their Royal electric typewriter. Lots of hand operations, lots of chances for scrap-making fumbles. Still, production costs were satisfactory . . . until suddenly the production rate had to be almost doubled. Costs really jumped.

Their TRS man suggested dropping solid rivets for semi-tubular ones, automatically machine-fed and set, with a special TRS-designed loading fixture to fumble-proof the whole operation. Result: the increased number of perfect assemblies a day . . . with the same operating crew using standard TRS riveters already available at Royal McBee.

Let the TRS man look over your assemblies. You'll find that he has the viewpoint of a manufacturing engineer, and an unusual knack for making fastening simpler, faster, better.

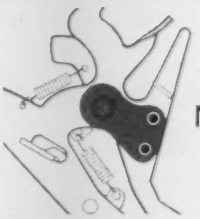
Of course he will recommend TRS rivets. But he will give you sensible reasons why they are more reliable in essential qualities and uniformity. Superior Quality Control is one significant result of a five-year modernization of this pioneer company. Modernization of people, policies, production and service facilities. *You'll like to do business with the new TRS . . . we'll make sure of it.*

THE CHANGE THE **TRS** MAN MADE



OLD

Two operators assembled 2 solid rivets and 1 shouldered stud into countersunk holes of trip pawl, placed this on a tray, then placed carrier arm over stud. Third operator positioned bearing plate over rivets and stud, lifted the loose assembly from the tray and slid it under a staking machine to stake the 2 rivets.



NEW

The countersink is eliminated, in all three locations. On the special TRS sliding fixture, each operator assembles all components over 2 locating pins, with the stud in place. The loaded fixture is then slid into riveting position, and the riveter is actuated by a foot lever to fasten the assembly with 2 semi-tubular rivets.

*Don't Buy Riveting Machines until you learn how the TRS* **PAR** *process revolutionizes riveting*

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TUBULAR RIVET & STUD COMPANY

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See "Yellow Pages" for phone numbers.

*If it's a Tubular Rivet TRS makes it . . . and Better*

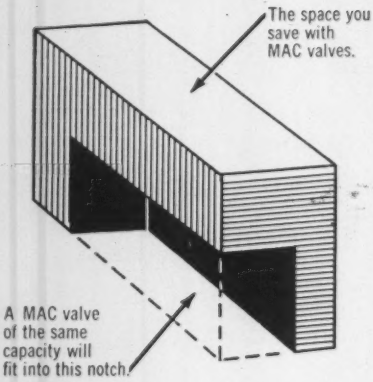
# Cuts Air-Valve Size 67% with New Design

*Also Boosts Performance, Life, and Ease of Service*

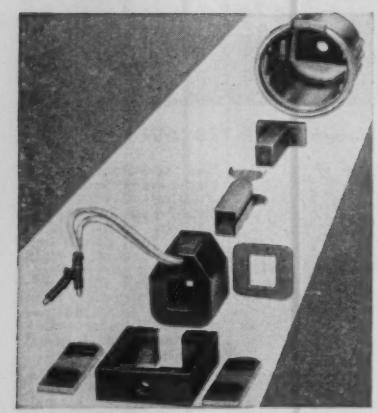
A remarkable new line of pilot-operated air-valves—the MAC series 300—cuts space requirements to ⅓ of that normally required for valves of equal capacity rating.

Not only is the valve extremely simple in operation, reducing cost, but the three moving parts can be replaced in a matter of 1 to 2 minutes without special tools. Life of moving parts is rated at 30,000,000 cycles, minimum.

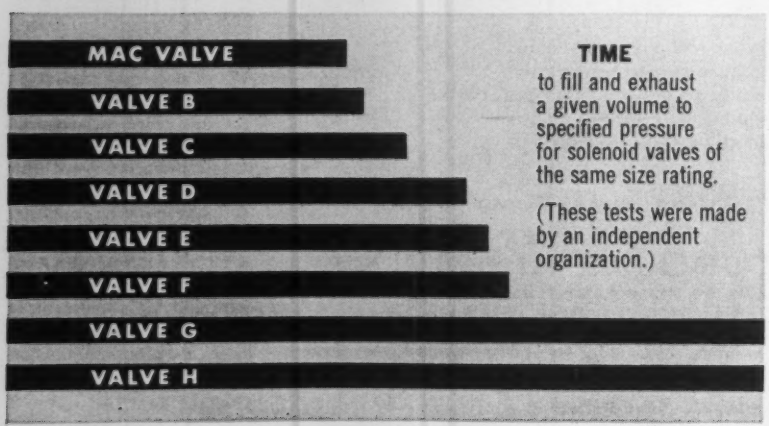
The story of how this was accomplished, together with valve sizes and specifications, is contained in Bulletin #300A available from Mechanical Air Controls on request.




# New Solenoid Boosts Valve Life —Virtually Foolproof, it also has Lighter Draw



A virtually failure proof solenoid which can be completely assembled or taken apart without any tools—but which can't be assembled wrong has been developed by Mechanical Air Controls. It has no welds to break or crack. It has no screws, nuts, bolts or other fasteners to work loose. It has a fully encapsulated water and oil resistant coil. There is no wiring through air valve body. The connections just plug in. The entire assembly floats on rubber mounts, the rubber being in shear. The solenoid has a lower draw because of the lighter push required. The design provides for both locking and manual jogging. It is standard on every MAC series 300 air valve.




# *advances in* PNEUMATICS

MAC

# designing an air valve . . .

There are two ways to design air-valves. One is for a specific job, and no more. For example, a valve in a missile usually has to function only once. Wear life is no problem. The other way is to design a valve for the *toughest* job it might face and then use it on easier jobs, too.

Any engineer would prefer the second way, but he wonders "Won't it cost too much?"; or "Won't I be criticized for providing more performance or life than needed?"

His worries are pointless. The second way doesn't have to cost more. Extra performance and quality can be a free "plus." If you design air-valves for the TOUGHEST jobs they can encounter (as we did at MAC) you can naturally get a simpler, more compact, easier-to-service valve; plus extra performance reserve—all AT LOWER COST.

Why? Once the valve licked the toughest application—where speed, reliability, serviceability and life were MOST vital—we simply standardized for mass production. That's how we wound up with a better and lower cost valve . . . the series 300.

President

MAC

**MECHANICAL AIR CONTROLS, INC.**

10030 Capital, Oak Park • Detroit 37, Michigan



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# More Enduring

Why are manufacturing engineers at work in most wide-awake industries diligently advancing automation techniques wherever possible? The answer is simple—productivity.

In many industries it is evident that just to remain competitive, an average three to five per cent productivity increase is needed yearly. Experience has shown that a nominal three per cent can be expected from continual planning and normal improvements in equipment and materials. But with inflation pushing up wages and materials costs on many fronts, increases in productivity considerably greater than three per cent are necessary.

Geared to major changes in product design thinking and good manufacturing research, automation can provide whatever productivity increase is needed. Through aggressive and imaginative development of new methods, advances of 20 per cent and higher have been realized in specific instances. Particularly pertinent from the standpoint of management thinking in this regard is this statement by Gerald Leland, vice president and general manager of G. H. Leland Inc.:

"Large basic industries, such as chemicals and steel, have made outstanding contributions through formal, programmed research in methods and processes. The smaller component manufacturer, however, has perhaps been more guided by immediate industry need and has tended to neglect these increasingly important areas. Our own company, for example, has concentrated on research and development in new products and product improvement.

"I say 'increasingly important,' because I believe that in the future cost reduction through automation is the answer to threats of low-priced foreign competition for all American industry. Further, from the individual company's own viewpoint, competitive advantages gained through process and manufacturing research are likely to be more enduring than those resulting merely from new product hardware."

EDITOR

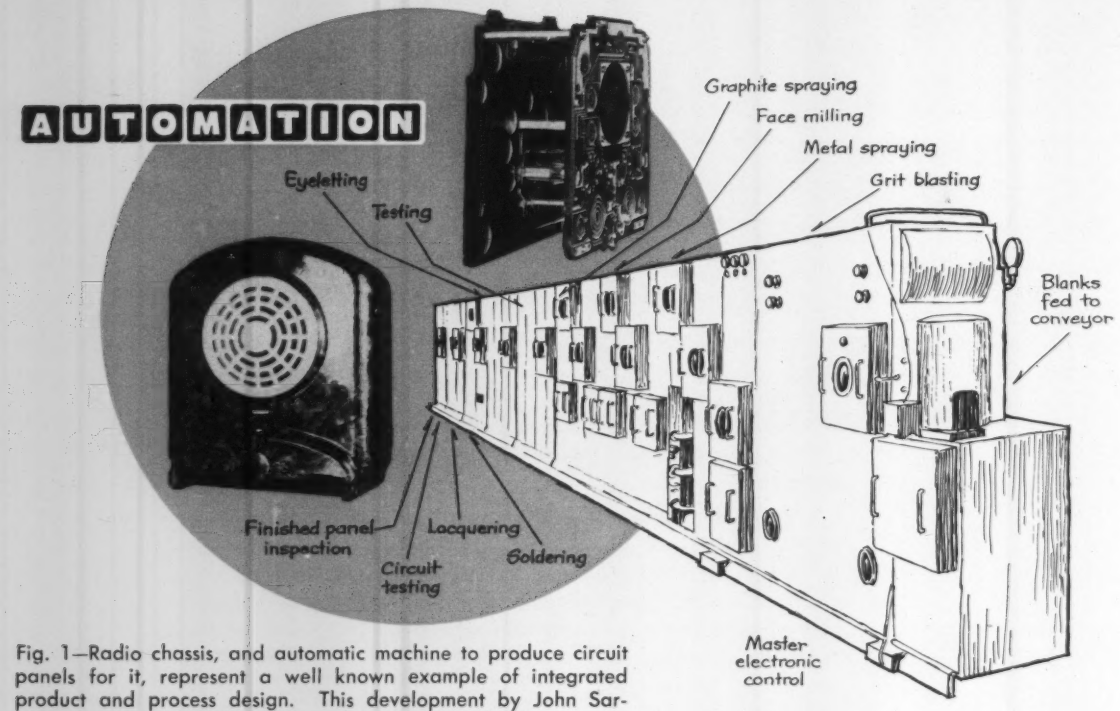



Fig. 1—Radio chassis, and automatic machine to produce circuit panels for it, represent a well known example of integrated product and process design. This development by John Sargrove took place in England shortly after World War II.

## A BASIC APPROACH TO AUTOMATION

# INTEGRATING PRODUCT AND PROCESS

By **RODNEY C. GOTT,** Executive Vice President, American Machine & Foundry Co., New York, N. Y.

WE ARE BECOMING quite accustomed to automated production lines where fairly standard machines and inspection stations are connected by automatic transfer means. Parts move from one machine to another by conveyor, are picked up, oriented, loaded, machined, checked, and ejected to the conveyor leading to the next machine.

Another example is the modern oil refinery which can be programmed to produce a variety of product mixes. It has automatic transfer of its products through continuous piped flow from one operation to the next. Further, all operations are monitored by suitable instruments, and the results fed back in a closed loop system to regulate the operations so that the product is kept within its programmed specifications.

These examples are what I would call classic, or conventional automation, in which an existing operation, that has been mechanized, is first programmed, secondly equipped with automatic transfer, and finally provided with self-regulation. We can, by these steps, reach the "Look Ma; no hands!" stage. I venture to say that there isn't one manufactured product made today that could not be produced automatically by the classic approach outlined here, provided, of course, that time and cost were of no concern.

Unfortunately the stern requirements of economic justification exclude many products from the benefits of this type of automatic production. Either the product is too complex, has too many parts, or is subject to frequent specification changes

This article is based on a speech delivered to the American Institute of Consulting Engineers, February 4, 1959.

**Economic factors may make a classic approach to automation impractical. But a co-ordinated program of product design and process development can result in a superior product fabricated at lower cost. The trick is to design the product to fit the process just as the process must suit the product.**

so that the quantities produced are too small to justify changeover costs. There are many products that just do not economically lend themselves to classic automation methods.

## Integration of Design

There is a solution, however; one which is destined to assume greater and greater importance as production techniques develop. This solution is the application of integration of design to the automation process, in which the product is every bit as much designed for the process as the process is for the product. To be fully successful, this approach requires complete redesign of the product, from its raw materials through to its packaging. Only by such action will automation ever be successfully applied to most products.

This approach is certainly not easy. We can go so far as to put lugs on whiskey bottles to orient them in the labeling equipment, and we can put flats on pistons for the same purposes. Many products, however, can't be touched at present, partially for reasons of material limitations but mostly because of the factor of consumer acceptance.

We do have some examples of the integrated approach to automation, in which the product was completely redesigned for the best production methods. A classic case, *Fig.* 1, is the radio chassis machine built by John Sargrove in England over ten years ago, in which the wiring and many of the components were automatically fabricated on a plastic chassis right in the machine. This development was in many ways too far ahead of its time and technology, but the same principle that produced the somewhat unorthodox-looking Sargrove radio is in use today to produce a variety of partial circuit sections of electronic gear, *Fig.* 2, in which resistors, capacitors, and circuit wiring have been completely redesigned so that the unit can be produced in one automated line practically from raw materials. Another approach to automation for electronic circuits led to the Project Tinkertoy development, *Fig.* 2, of which much has been written.

## Bread Making

I'd like to illustrate the integrated design approach in somewhat more detail by describing a few products or processes which we have developed or are developing. AMF supplies to the trade a new and improved continuous bread-dough making process, *Fig.* 3. Although we had to be very careful not to downgrade the flavor or texture of the bread baked from this dough, we could and did revise drastically the process that produced the product. In fact, this change proved necessary to achieving the end result, which is the automatic production of bread-dough, loaded into pans, and on its way through the proofer prior to being baked.

A certain number of operations have always been

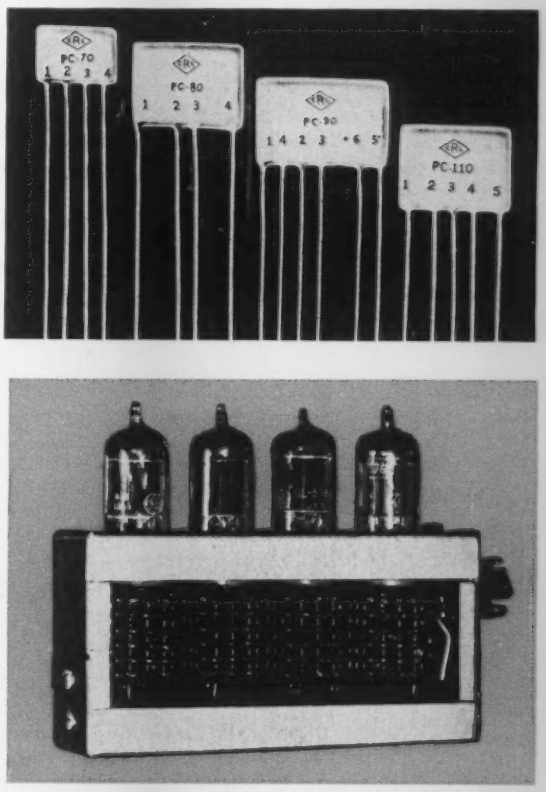



Fig. 2—Designs of electronic circuit sections have been developed to make automatic production more feasible. Components manufacturers have developed prepackaged elements, such as at top, that combine resistors, capacitors, and some wiring in a single unit. More elaborate system, shown at bottom, was developed in Project Tinkertoy and based on stacking a number of circuit units to form a larger unit.

considered necessary in a typical commercial bread bakery, which uses the conventional batch process. First, all of the ingredients are mixed together to form a sponge, which is poured into troughs and allowed to ferment. This causes the dough to rise through the production of carbon dioxide gas. During this initial fermenting stage, the sponge may be remixed, the gas squeezed out, and the dough allowed to ferment further. During all this time the dough is handled in troughs, weighing from 1600 to 2000 lbs loaded, which require a variety of lifts and trolleys to move them from one place to another and from one step in the process to another.

Following fermentation the gas is again squeezed out of the dough, and it is divided into unit size pellets. The pellets are rounded to seal the edges, and conveyed through a second fermentation, or proofing stage. Here the dough is again allowed to rise. Finally, the gas is again squeezed out and the pellets molded into the proper shape, placed in pans, and allowed to rise for the last time. Following final proofing, the pans of dough are baked, cooled, sliced, wrapped, and cartoned.

## ▶ Automated Dough-Making

Various steps in this process have been mechanized individually, and in a modern bakery all of the steps following the dividing operation can be handled almost entirely automatically. The major problem comes in the steps prior to this. It would, of course, be possible to apply classic techniques to the initial mixing and fermentation stages, with automated lift trucks, special conveyors, etc., but the problems of instrumentation and control of the chemical and physical reactions are quite formidable.

In tackling this problem, it became necessary to make some changes. We couldn't change the end product, the loaf of bread, but we could and did change the process and intermediate products to facilitate the automation process. The keys to accomplishing this were, first, to maintain the material in a sufficiently liquid state to permit pumping from one operation to another and, second, to sequence the steps in the process to eliminate the necessity for repetitious mixing and fermentation.

Our continuous bread-dough making process is divided into two parts—a fermentation system and a mixing system. Starting off, yeast and sugar, forming an actively fermenting brew, are brought into contact with a certain portion of the flour and part of the other ingredients in a blending tank. This mixture is allowed to ferment for three hours. One hour of this takes place in the blending tank itself, a second hour in one of two liquid sponge tanks, which are tapped alternately, and the final hour in continuous flow through a liquid sponge trough. By putting only a small portion of the flour into the sponge during these early stages, the mix is maintained in liquid form and can be pumped. We have found that we can use as little as 16 per cent of the total flour here and still develop the full flavor of the bread, but to do this we have to feed back a small portion of the mature liquid sponge to the start of the subsequent brew, thus giving us a portion of the final mix which has been in contact with the active agents for a total of six hours, and which will contain certain desirable late-forming products of fermentation.

In the mixing system, the remaining ingredients are added, winding up eventually with the balance of the flour. The entire mix, under pressure, is first homogenized in an incorporator and then developed into the gluten structure which we call dough. In spite of this change in the process, we have been able to adhere to the three basic fundamentals of making good dough, which are: The fermentation to produce carbon dioxide gas to make the dough rise, the development of the plastic or gluten structure to hold this gas, and finally, the creation of the necessary flavor elements.

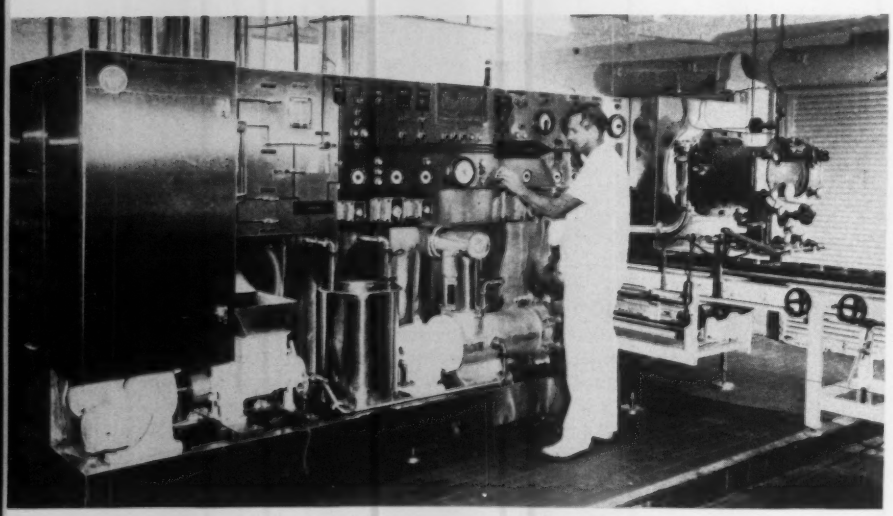


Fig. 3—Equipment for continuous fermentation and mixing of bread dough required revision of traditional process steps and intermediate product forms. Equipment, built by American Machine & Foundry Co., has an hourly capacity of 4000 to 6000 pieces of bread dough ready for panning, final proofing, and baking.

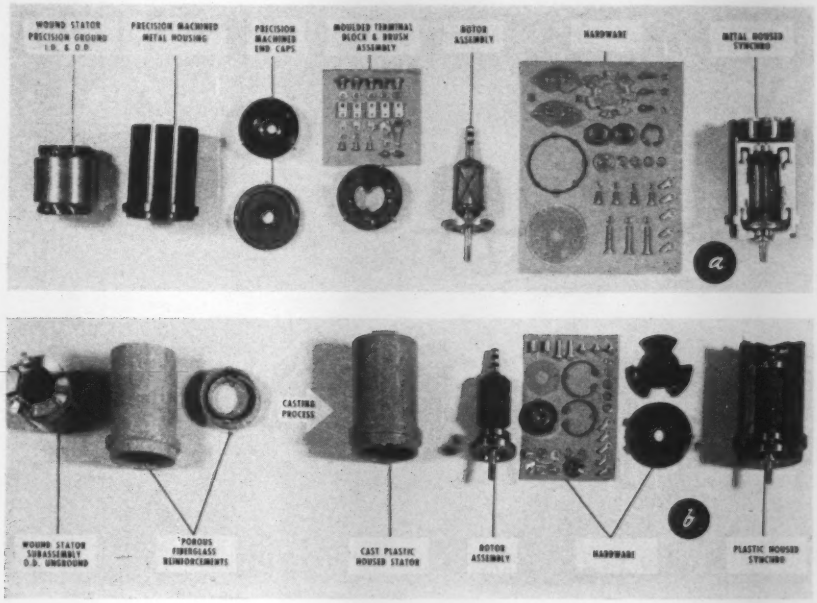



Fig. 4—Synchromat program studied existing design of synchros *(a)* and developed new design *(b)* to be produced by automatic production processes. Number of parts was reduced from 75 to 50, assembly simplified, and a superior product obtained.

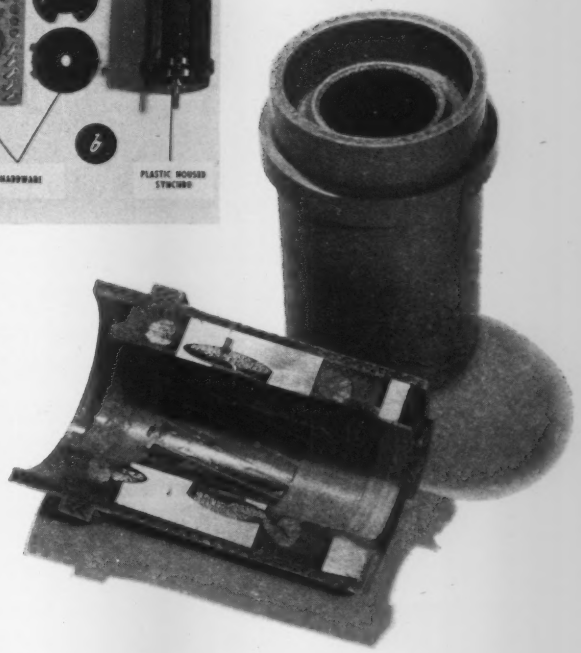


Fig. 5—Stators for the redesigned synchros represented a major area of change. The plastic housing molded directly to the stator eliminated the need for a machined metal housing and end caps, a precision grind on the OD of the stator, and a separate molded mounting for a brush and terminal assembly.

In addition, we have also wound up with a number of other advantages. First, floor space requirements have been cut down. Second, direct labor requirements have been reduced. Thirdly, uniformity and quality of the product has been improved. Finally, almost as a dividend, we are able, through environmental control of the pressure and temperature, to produce a dough ready for immediate panning. Considering the conventional method of making bread, this means that, in addition to replacing the mixing and initial fermentation equipment, we have also succeeded in eliminating the need for rounding and intermediate proofing. Instead, we can divide and mold directly into the pans, thus eliminating two more pieces of equipment as well as the necessary connecting conveyors.

## ▶ Unfettered Approach

I am sure that many people can bring to mind other examples in industry of the integrated approach to automation, but I'm equally as sure that they can't think of very many where it was permissible to completely change the product or the process in order to facilitate automation. In this respect, the military, in its production of arms and equipment has a big advantage over private industry, since the end user is not as yet in a position to refuse the product and actually doesn't care as long as it does the job.

Because of this, the Armed Services are quite possibly ahead of industry in sponsoring completely unfettered approaches to automation. We have been fortunate enough to have worked with them on two sizable projects.

The first of these was called the "Synchromat" program. It started back in June of 1952 as a study of the various steps in the production of synchros, to minimize the need for skilled manpower. Synchros are used to transmit positional signals or instructions in all types of automatic equipment, particularly in fire control and automatic piloting. Demand builds up fabulously during a war, but it takes highly skilled personnel and close manufacturing control to produce accurate and reliable units.

A synchro basically consists of a wound rotor, a wound stator, the mechanical housing and bearings to position the two, and electrical contact elements, such as terminals, brushes, slip rings, etc. After initial studies showed that the production of rotors could be automated by fairly conventional

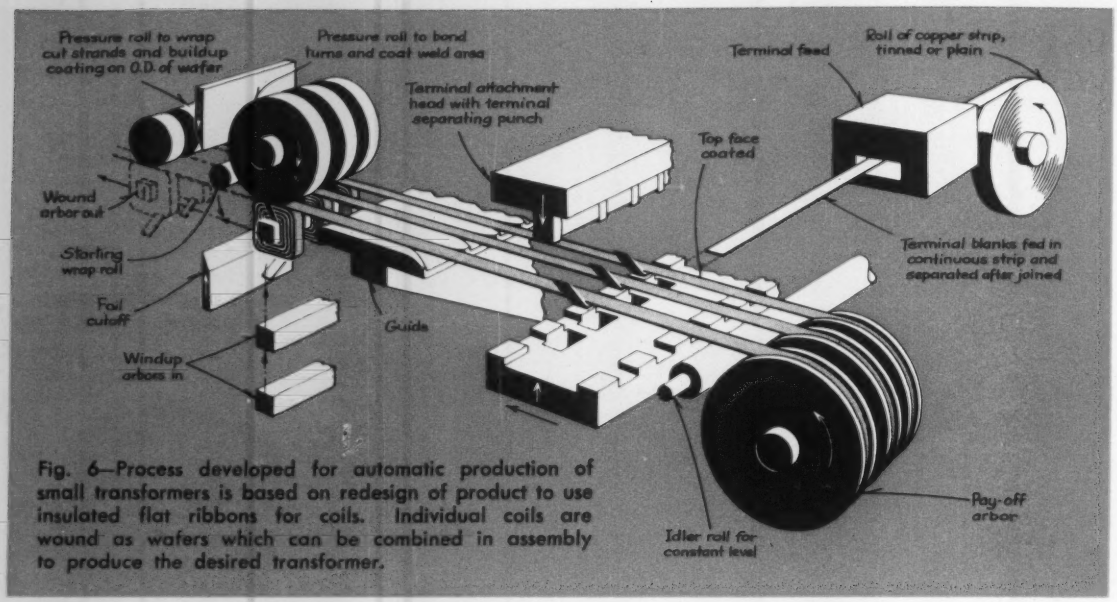

Pressure roll to wrap cut strands and buildup coating on O.D. of wafer
Pressure roll to bond turns and coat weld area
Terminal attachment head with terminal separating punch
Terminal feed
Roll of copper strip, tinned or plain
Top face coated
Wound arbor out
Starting wrap roll
Foil cutoff
Guide
Windup arbors in
Terminal blanks fed in continuous strip and separated after joined
Pay-off arbor
Idler roll for constant level

**Fig. 6—Process developed for automatic production of small transformers is based on redesign of product to use insulated flat ribbons for coils. Individual coils are wound as wafers which can be combined in assembly to produce the desired transformer.**

means, our interest centered on the stator, the mechanical parts, and the final assembly.

## ▶ Synchro Stator Program

The problem of automatically winding the stator to the extreme precision required was solved in a fairly straightforward manner by the development of a machine which can wind a complete stator automatically, using wire as fine as No. 40. The most interesting phase of the Synchromat program from the standpoint of automation, however, came when we began to consider the housing and final assembly sequence. In *Fig.* 4 are shown a cross section of a standard synchro and a spread of the parts that are needed to make it up. These include a wound stator, precision ground both on its ID and OD; a precision machined housing and end caps; a molded terminal block and brush assembly which contains in itself over 25 separate parts; and 40 additional hardware items.

The solution involved a complete redesign of the housing and the method of fabrication. The end result is a fiberglass reinforced plastic housing, *Fig.* 5. The plastic is molded directly around the wound stator by a precision centrifugal casting method. This not only eliminates the accurately machined metal housing and end caps but also does away with the need to grind the OD of the stator. Furthermore, not only does the plastic housing "pot" the stator coils for full protection from the elements, eliminating all the lacing and varnishing formerly necessary, but the finished article appears to be superior from a mechanical standpoint. As a final dividend, the change to a plastic housing permitted casting in all the configuration necessary to mount a simplified brush and terminal assembly, thus eliminating the separate molded unit necessary in the conventional synchro.

Total parts have been reduced from 75 to 50, the assembly has been vastly simplified, and a superior product has resulted.

The synchro program has by no means reached the automatic factory stage. However, the studies so far have demonstrated that automation of the major and critical subassemblies of these devices is entirely feasible, provided only that the integrated design approach is used, and the product changed to fit the tools available.

## ▶ Transformer Production

The last example of the integrated approach to automation that I want to mention here is a project for automating the production of small transformers. Even more than synchros, transformers are a widely-used component of electronic and electromechanical gear.

During times of war and heavy preparedness, transformers too are in short supply. In addition, electronic circuits require a very great variety of transformers, many of which differ in only minor respects from one another. Thus, even though the total volume of transformers of one size may be large, the quantities of any one particular model may be too small to justify the special setups required on conventional automatic equipment. The need for flexibility was, indeed, a governing specification in the project.

Conventional coils for transformers are wound on semiautomatic machines, from continuous lengths of round insulated wire. Each separate section is wound on top of the other and the individual leads brought out at the ends of the coil stack.

It was early apparent that to automate the winding and lead termination of a conventional trans-

former would be extremely difficult. On the other hand, there already existed in experimental form a concept of winding coils from flat insulated ribbon conductor, in the form of wafers. Using these wafers, as building blocks, it was felt that a relatively simple automatic setup could be created to wind individual wafers, stack these side by side and connect the ends in series. Connections to each coil, or even to each wafer, would be readily available and in precise position for mechanical connection to a terminal block.

Furthermore, wafers of different size could be made ahead in quantity, stored in magazines or hoppers, and selectively picked out for the final assembly. Carrying this concept still further, it would even be possible to set up a completely automatic assembly machine in which just one special transformer could economically be produced in response to specifications dialed or fed in from tape.

Needless to say, there are a great many difficulties that have been and still have to be overcome before a high degree of automation becomes a reality, but the basic process is well along in its development and appears completely feasible.

In the latest method, *Fig.* 6, aluminum foil, coated on one side only and in wide rolls, is first split into individual strips and the edges folded under to provide complete insulation for sides and ends. The folded ribbons are then fed through a terminal attaching operation, where, periodically, and under program control, transverse terminal tabs are fed in, attached, and cut off to length. The foil continues to a winding station where it is formed up on arbors into wafers, with the connecting tabs sticking out the end. During this operation a heated pressure head seals the individual turns together, giving a mechanically rigid and completely protected structure. When one wafer is completed for the prescribed number of turns, it is automatically severed from the foil and a fresh one started on a new arbor.

Once wafers such as these have been produced, automation of the remaining elements of assembly is greatly facilitated. In the flow diagram of our proposed method, *Fig.* 7, the wafers would be assembled onto cores in programmed sequence, the core would be assembled into a metal shield, the accurately positioned terminal tabs on the wafers would be connected to a terminal board, or interconnected, if more than one wafer is necessary in one winding, and the final assembly would be housed or potted.

Sample transformers embodying these design concepts are nearing the end of extensive tests. If fully acceptable, we hope to be able to proceed with the construction of a fully automated wafer transformer line to produce this product.

These then are examples of the integrated approach to automation, which can only be achieved by a complete marriage of the product to the process.

## Operation Co-operation

The last half century has seen many new products, and changes to old products, introduced into our daily living pattern. These for the most part resulted from new technical discoveries or new materials. The next half century will see as many more changes in things familiar to us, but these changes will be dictated more and more by the necessity to manufacture them with a minimum of manual labor.

This necessity is going to pose many new problems for the product designer and is going to require the utmost in co-operation from all those involved in developing and producing volume products, including the chemist who develops the materials, the engineer who develops the product concept, the designer who gives it its final form, and the factory team that devises and operates the automated production line.

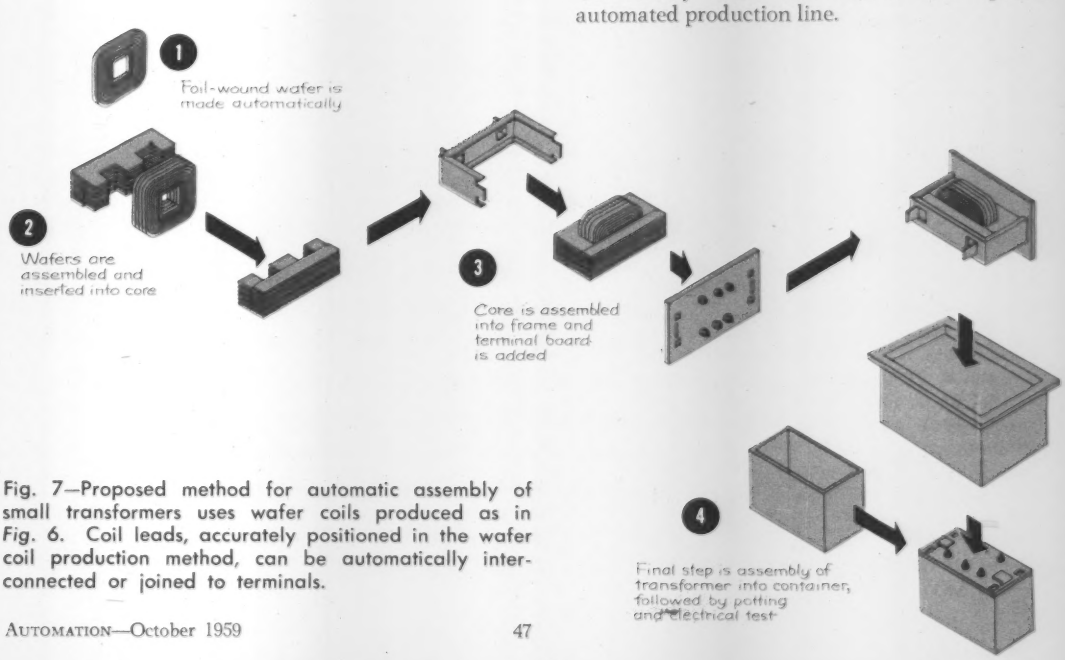
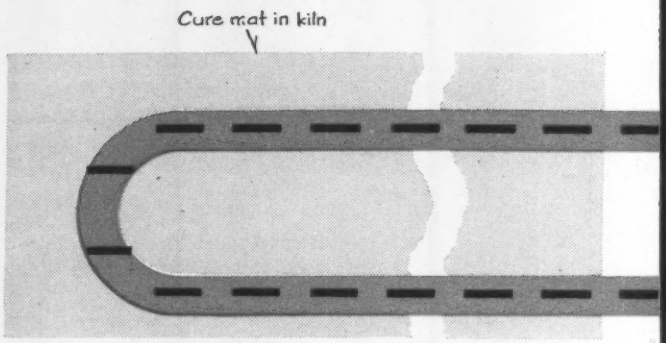

1
Foil-wound wafer is made automatically
2
Wafers are assembled and inserted into core
3
Core is assembled into frame and terminal board is added
4
Final step is assembly of transformer into container, followed by potting and electrical test

**Fig. 7—Proposed method for automatic assembly of small transformers uses wafer coils produced as in *Fig.* 6. Coil leads, accurately positioned in the wafer coil production method, can be automatically interconnected or joined to terminals.**

1

This automatic production line for casting concrete mats produces 80 mats per hour. After a completed mat is unloaded from its sheet steel pallet (far right), the pallet is conveyed on a cradle past a cleaning station which brushes off any remaining particles from previous castings. Steel fabric is next clamped onto the pallet, and the unit is oiled to prevent the fresh concrete from sticking. After being formed in the casting machine, the mat is conveyed through a curing kiln, lowered to the return leg of the conveyor, and moved to the unload point. Total time from casting to unloading is approximately 138 minutes.



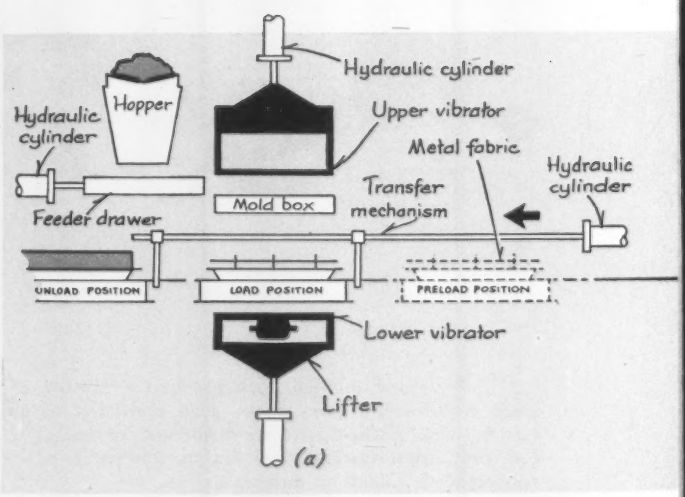

AUTOMATION TODAY

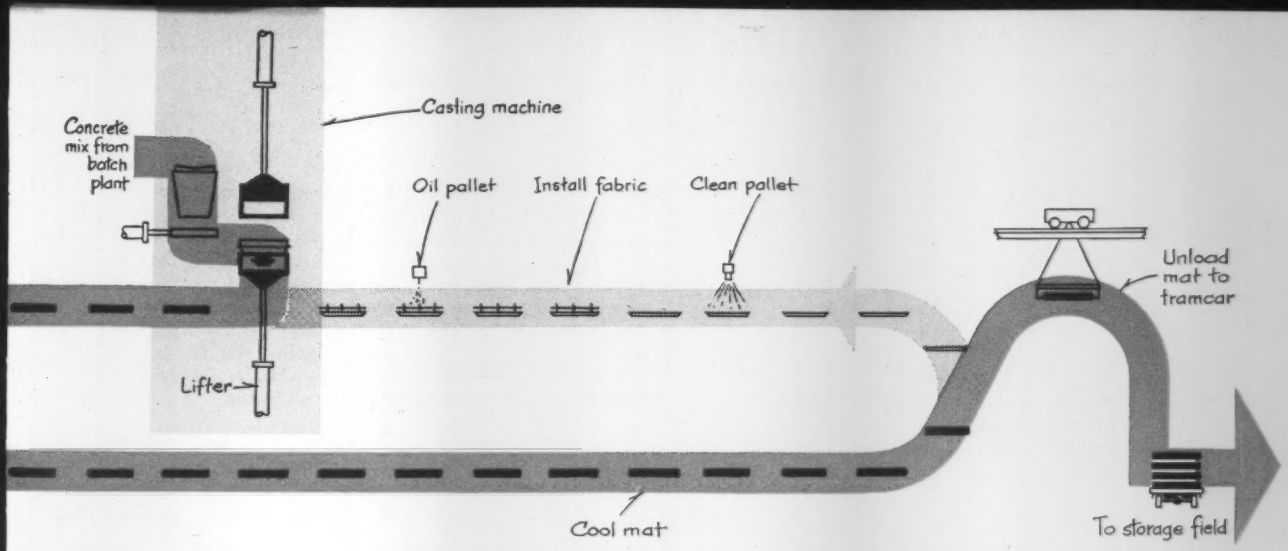
# CASTING CONCRETE MATS

By LEWIS B. LLOYD
Safety Engineer
U. S. Army Engineer District
Memphis, Tenn.

2

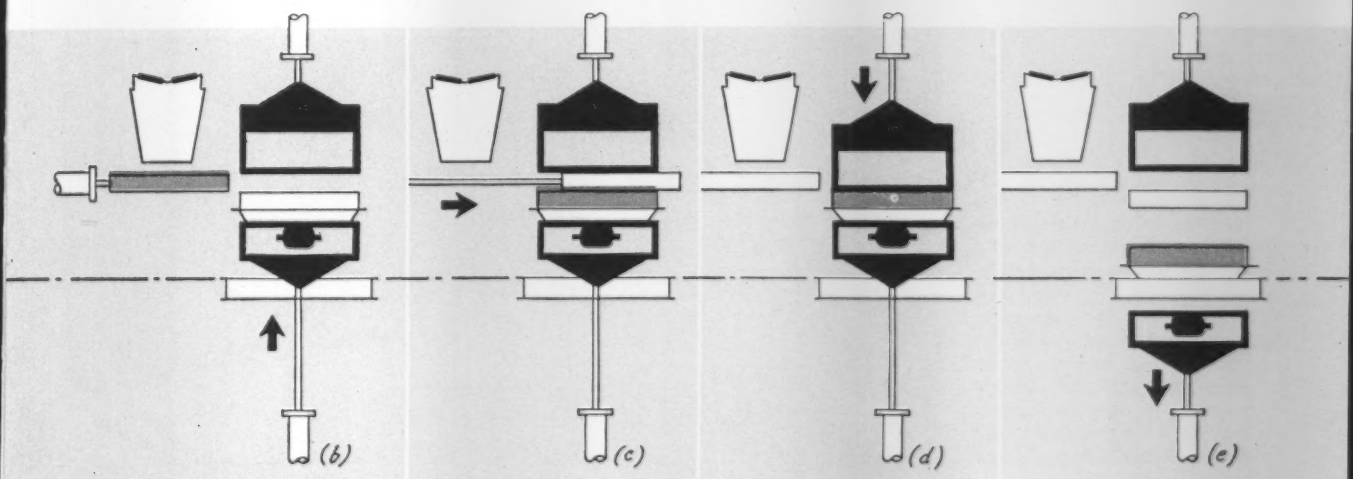
The conveyor used in the casting line is a two-level system of the endless chain type with approximately 12 feet between levels and a 28-foot span between rails. Suspended between the rails are 161 cradles which are spaced at 6-foot intervals. Each cradle holds a sheet steel pallet which is slightly larger than the 4 by 25-foot concrete mat. As the cradles move at 6 feet per minute toward the casting machine (far left) two men install the copper-clad steel fabric into clamps on each pallet. This is the only manual operation on the production line.

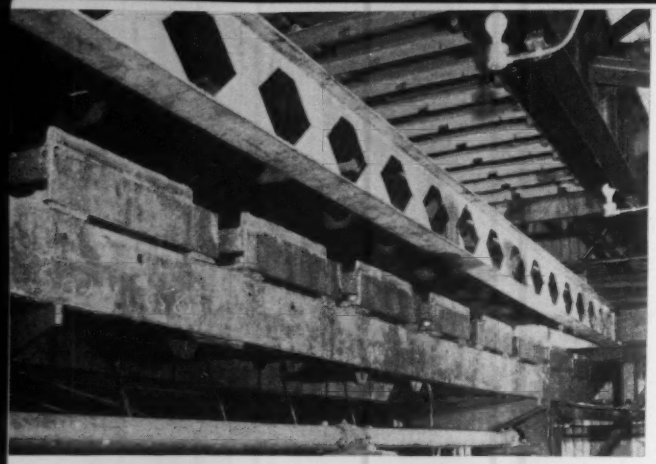





THE heavy construction field is usually identified with highly individualized projects such as building roads, bridges, and buildings. Projects of this nature do not normally lend themselves to cost-saving production line techniques that have been developed over the years by industrial manufacturing plants. Occasionally, however, a construction project is concerned with building a non-industrial product in sufficiently large lots that manufacturing techniques can be applied with substantial savings in labor and material costs. Such a project is the manufacture of concrete mats which

3 This diagram illustrates the sequence of operations occuring in the automatic casting machine. When a cradle and pallet has been conveyed to the preload position (a), the cradle is mechanically disconnected from the chain conveyor. A transfer mechanism actuated by hydraulic cylinders then moves the cradle from the preload to the load position at the same time that it moves a cradle holding a cast mat from the load to the unload position. The pallet is next raised against the bottom of the mold box by the lifter (b) which is actuated by two hydraulic cylinders. During this time, a shuttle conveyor moves across the top of the casting machine hopper over the feed drawer and empties a load of concrete mix from the outside batch plant. Two hydraulic cylinders then push the feeder drawer across the top of the mold box (c), filling the mold box with concrete mix. On the return stroke, the feeder drawer strikes off the mix flush with the top of the mold box. The upper vibrator head is lowered by two cylinders (d), and the mix is vibrated for 20 seconds by the upper vibrators and 10 vibrators mounted beneath the mold box on the lifter. After the upper vibrator head retracts (e), the lifter lowers the pallet, holding the newly cast mat, onto the cradle. The transfer mechanism then moves the cast mat from the load position to the unload position where the chain conveyor again mechanically engages the cradle and conveys the mat through the curing kiln. Total elapsed time for this machine cycle is 51 seconds.





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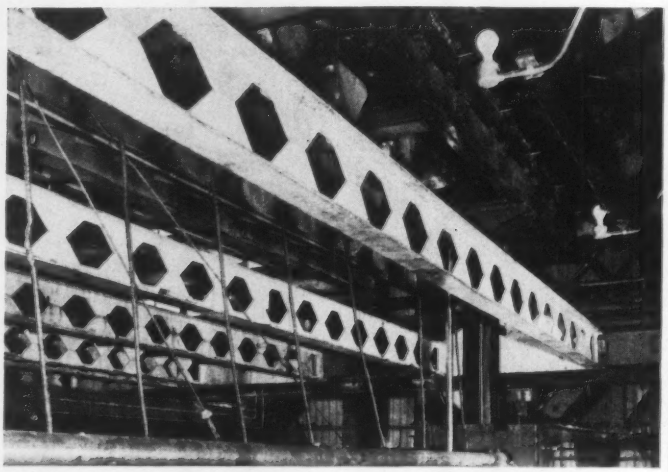
These views show a cradle in the load position below the casting machine. The horizontal beams with the hexagon cutouts are the sides of the cradle. In the picture to the left, the lifter is in a retracted position directly below the cradle. Immediately above the cradle can be seen separating forms in the mold box. In the picture below, the lifter has been actuated and has raised the sheet steel pallet against the bottom of the mold box. Visible between the lifter frame and the cradle are several of the lower vibrators.

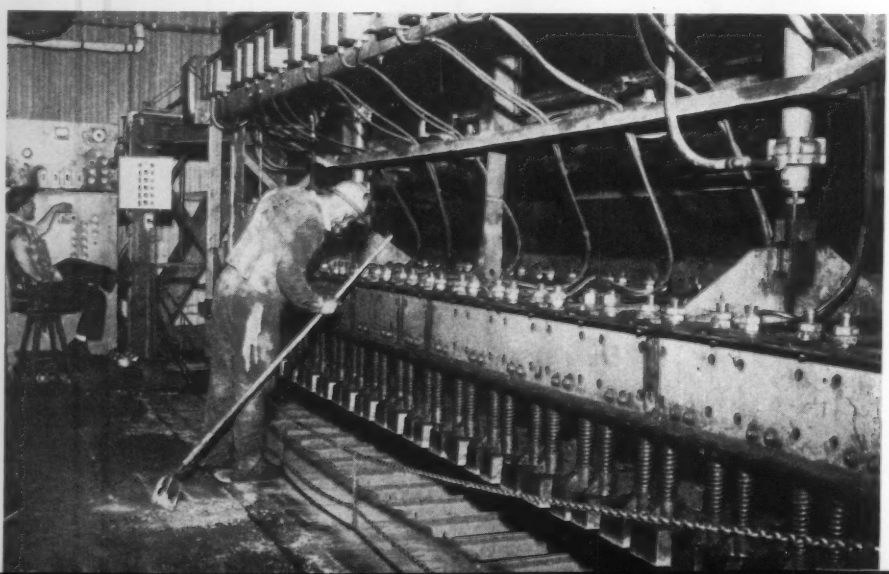


are used along the banks of the Mississippi River to prevent erosion and to stabilize the navigation channel.

The concrete mats are built by a private construction firm under contract to the U. S. Army Corps of Engineers, Vicksburg District. Each mat is 4 feet wide, 25 feet long, 3 inches thick and weighs 3464 pounds. To provide flexibility when lying on irregular river banks, the mat is constructed of 20 individual concrete blocks which are held together by an imbedded copper-clad steel fabric. In the manufacture of 100,000 mats, over 83,300 cubic yards of concrete are used

Prior to the introduction of a continuous production line, the concrete mats were produced on an outdoor casting field which was more than a mile in length. From 600 to 1200 steel forms were arranged in rows in the casting field and were filled by trucks hauling concrete mix from a batch plant. In addition to being a seasonal operation and vulnerable to weather conditions, the field casting system required from 80 to 100 men to install the forms, pour the concrete, remove the forms, and cure the mats.

The casting of concrete mats by machine methods had been considered for many years; but, due to the size of the product and the necessity for early handling of the freshly cast mats, the problem seemed almost hopeless. However, after extensive experiments, high-early-strength concrete mats were produced by using an extremely low water-cement ratio, by employing external vibration in the casting operation, and by heat treating under controlled humidity conditions. Mats manufactured under these conditions developed sufficient strength to allow handling, without cracking the 3-inch slabs, in about two hours.



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This view shows the casting machine before the pallet has been raised against the mold box. An operator is inspecting the mold box which is at floor level of the machine platform. The upper vibrator head is in a raised position above the mold box. Directly behind the vibrator head is located the hopper and feed drawer that fill the mold box with concrete.

6

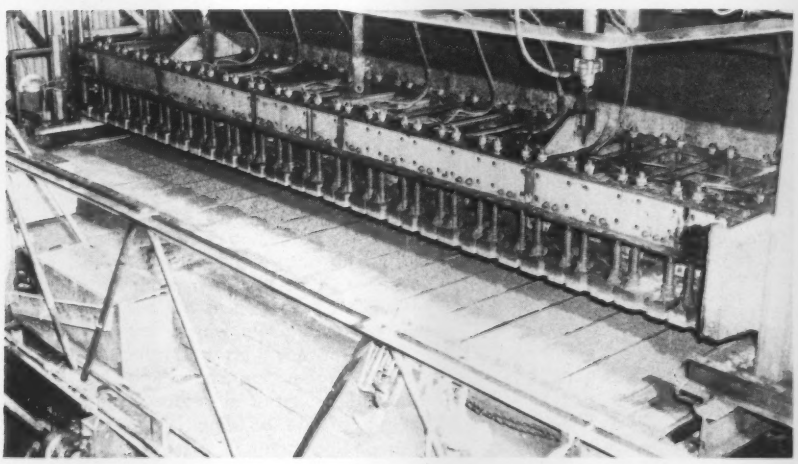
A shuttle conveyor is used to transport the concrete mix from the outside mixing and batching plant to the casting machine hopper. The conveyor assembly is on a track so that it can be moved from one side of the hopper to the other, across the width of the casting machine. This setup was necessary to allow the concrete mix to be uniformly distributed to all the sections in the hopper. The casting machine is located on the right of the shuttle conveyor.

The automated production line for casting concrete mats, shown in the accompanying illustrations, produces 80 mats per hour with a crew of 25 men. All operations on the line are automatic except for the initial task of placing a steel supporting fabric on each pallet. The system is designed to use both the upper and lower runs of a 468-foot long conveyor installation. On the upper level of the loop, the concrete mats are cast onto pallets which are carried by cradles through a curing kiln. On the lower level, or return leg of the conveyor, the mats are cooled to room temperatures and conveyed to an unloading point. The automatic casting process requires approximately 51 seconds, the mats are cured in the kiln for about 110 minutes, and 27 minutes are required after the mat leaves the kiln until it reaches the unloading point.

Key to the mechanization of this process was the development of a fast hardening technique for cast concrete mats. Experiments showed that curing temperatures are quite critical in relation to the size and shape of the product. Gradual increase and decrease of temperatures is important—especially controlled cooling. In the kiln section of the plant, five 2,700,000-Btu hot air furnaces supply heat to maintain the critical temperatures. Heat is introduced at 6 points in the kiln and is automatically controlled.

Of equal importance, the humidity in the kiln is maintained between 20 and 40 per cent. The humidity is automatically controlled by injecting steam into the kiln, and a 150 hp boiler is used for this purpose. Concrete passing through the kiln is case hardened on the exterior, but retains sufficient moisture in the interior to permit the completion of hydration when placed in the storage field. Tests have shown that the mats can be successfully handled when they have attained a flexural strength of less than 200 psi. However, the production line is designed so that the mats reach a flexural strength of about 240 psi before they are removed from the supporting pallets.

The casting machine was designed by Edwards Engineering Corp., New Orleans, and the conveyor system was provided by Link-Belt Co., both firms working in close co-operation with Corps of Engineers, Vicksburg District. The plant was built by the Corps of Engineers and is operated by private contractors who are selected on the basis of competitive bids for 100,000 mats. Under the contracts, any mat having four or more cracked blocks is rejected. However, this has been no problem since rejections are consistently under 0.6 per cent.



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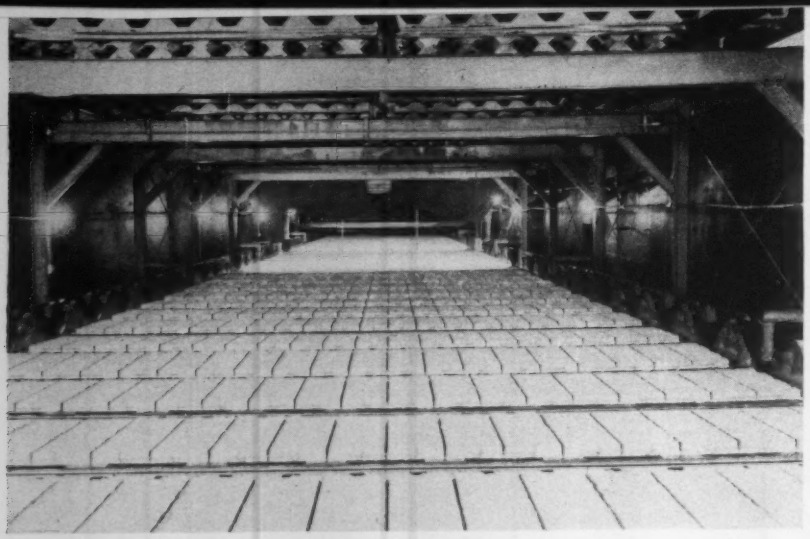
The mold box of the casting machine has been filled with concrete by the advance and retraction of the feeder drawer. The vibrator head is still in the raised position, but will now lower and vibrate the mix for 20 seconds. Three seconds before the upper vibrator starts, the 10 lower vibrators are energized and vibrate for 5 seconds. Immediately after the vibration cycle is completed, the lifter will lower the freshly cast mat and the pallet to the cradle. Then, in 3 seconds the cradle will be advanced 82 inches to the unload position for engagement with the chain conveyor which will move it through the curing kiln.



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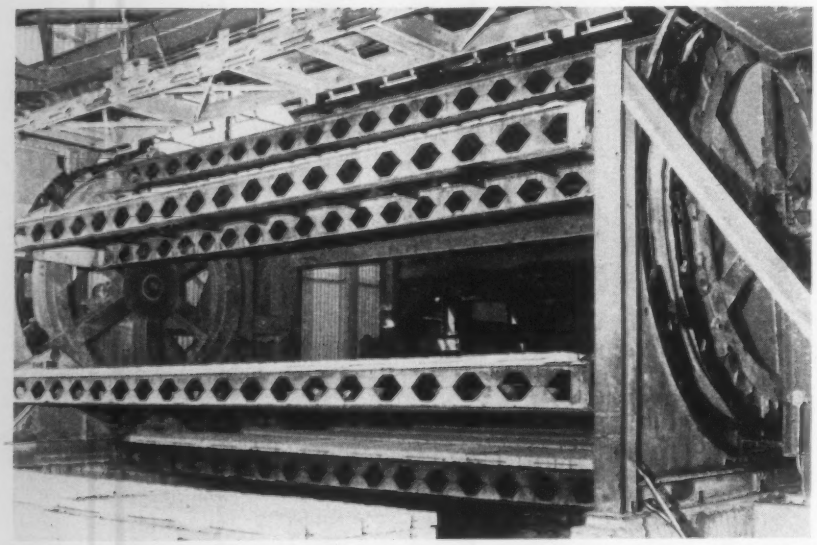
Three minutes after casting, the cast mat enters the upper level of the curing kiln at normal plant temperatures. The temperature gradually rises to 200F at the far end of the kiln where the mats are lowered approximately 12 feet to the lower level of the conveyor shown. The conveyor then carries the mats through decreasing temperatures and under the casting machine to an unloading area.

9

As the cradles leave the lower level and are returned to the upper level, the concrete mats are removed from the pallets by a handling frame suspended from a bridge crane. The frame grips the mats by means of the protruding fabric wires. At this point, approximately 138 minutes after casting, the mat has a flexural strength of approximately 240 psi which is ample for stacking and hauling to storage.



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During hot weather, the concrete mats are cured with water for approximately 5 days as they lie stacked in the storage field. After 7 days, the flexural strength of the mats has increased to 450-500 psi. In the background can be seen the 531 foot long manufacturing plant. The automatic casting machine is located inside the building and directly in front of the concrete batch plant. The low extension to the left is the curing kiln with 5 hot air furnace rooms and one boiler room for controlling humidity. At the extreme right of the building is the unloading point.

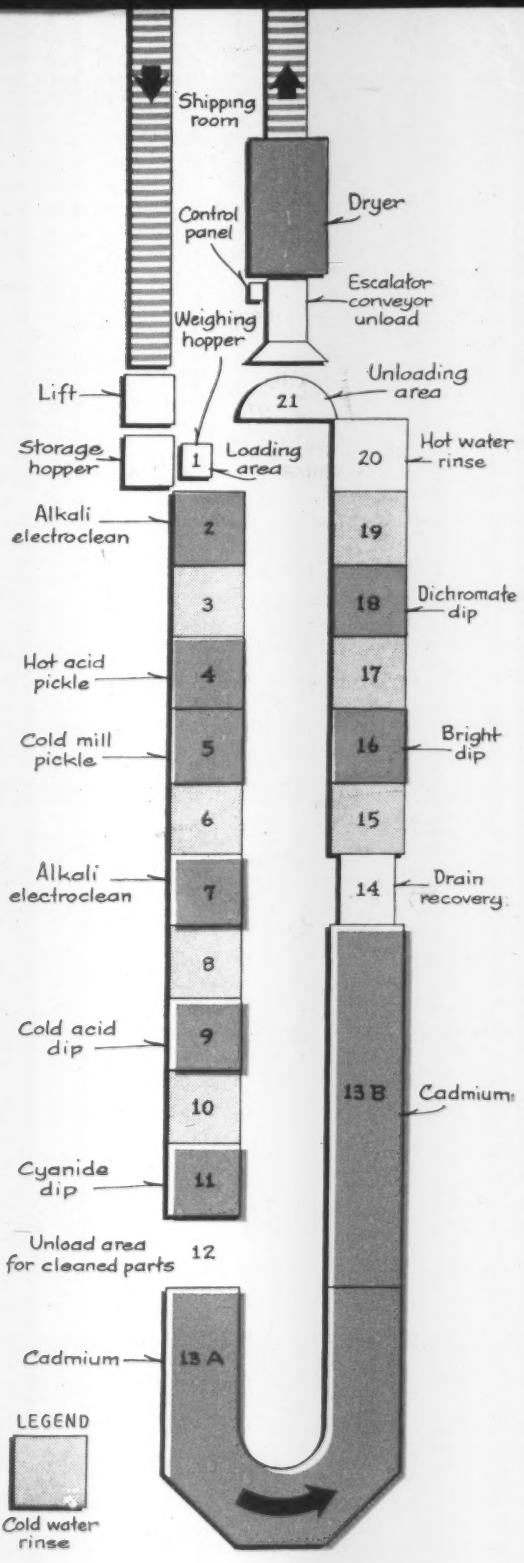


Fig. 1—Plan view shows the cadmium plating line installed at Bellevue Plating Co. Only two men are required to produce an output of 18 to 20 tons of parts per shift. One man operates the machine, and the other man inspects the parts and services the equipment. The system is designed to minimize the necessity for storage of parts in the combination receiving-shipping room or at the plating machine.

# HIGH-SPEED PLATING LINE

## TRIPLES PRODUCTIVITY

By **WILLIAM J. REIN**
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Bellevue Plating Co.
Detroit, Mich.

IN the highly competitive business of job-lot plating, fast customer service while maintaining top plating quality can mean the difference between keeping facilities busy on repeat orders or watching the jobs unload at a competitor's door. At Bellevue Plating Co., fast customer service means one day service—material received in the morning is plated and shipped the same afternoon—on high-speed plating lines which require only 5 men to receive, plate, and ship 40 to 50 tons of material per shift. To attain this type of performance from the two plating lines in the plant, the equipment was designed with one basic principle in mind—handle material as rapidly and efficiently as possible without sacrificing quality.

Bellevue Plating Co., owned by National Machine Products Co., specializes in rust-proofing small metal parts such as nuts, bolts, and screws with cadmium and zinc platings for the aircraft, appliance, and automotive industries. Although in operation for only a few years, the plating plant has attracted much interest from its automated cadmium barrel plating machine and its modern methods of materials handling that have reduced direct labor costs to a minimum.

When the cadmium line was being planned, the plating machine builders, Hanson-Van Winkle-Munning Co., were asked to provide the following features: 1. Maximum machine flexibility since as many as 30 different types of parts might be run through the machine in one shift. 2. Automatic machine operation to reduce labor costs and to eliminate operator error. 3. Mechanized handling of materials to reduce time between operations. 4. Plating solutions that would stand up under high current densities in order to reduce the actual plating time. 5. A machine that would remove guesswork from the plating operation so that quality would be maintained at a high level.

Of the five desired features, flexibility was considered the most important. The machine builder supplied a 2-speed machine that would allow an output of either 23 or 36 barrels per hour. In order

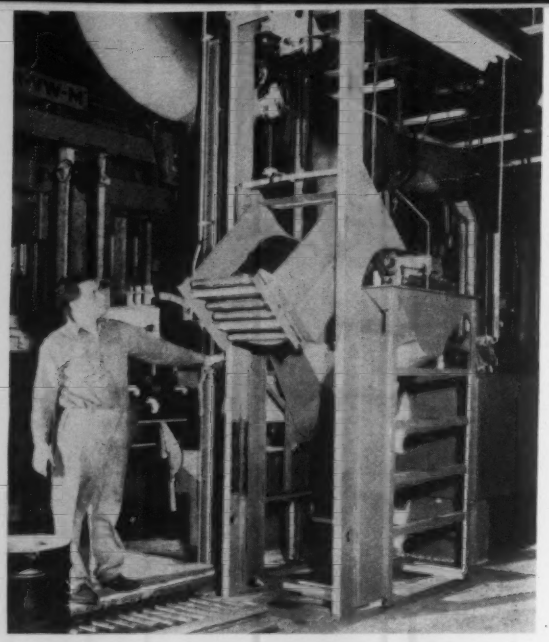

Fig. 2—Cans of parts are conveyed directly from the receiving-shipping room to the loading station of the plating machine. A mechanical lift raises the can of parts from the roller conveyor and dumps the parts into a storage hopper. Each plating barrel is then filled with a predetermined weight of parts which is equivalent to 75 square feet of plating surface. The unloading station of the machine is directly behind the operator so that one man can operate the entire machine.

that one man could load and unload the machine at one point, the plating line was built in a U-shape, *Fig.* 1. Since some parts require different plating cycles than others, additional flexibility of operation was provided by a mechanical programming system so that each barrel could follow a preset cycle through different solutions, independently of other barrels.

## System Operation

Incoming and outgoing parts are handled by one man in a combination receiving-shipping room. As the parts arrive for plating, they are weighed and a job ticket is prepared listing the weight of parts to be put into each plating barrel, the plating cycle required, and the total weight of the shipment. The plating cycle and the weight per barrel are determined from a prepared chart which was developed by actually measuring the surface area of each part to be plated and calculating the weight of parts necessary to provide exactly 75 square feet of surface area in each barrel. The parts and job ticket are then placed on a powered conveyor for direct movement to the cadmium plating machine.

At the machine, a mechanical lift raises the container of parts and tilts it into a storage hopper, *Fig.* 2. As parts are needed to fill barrels, the operator releases them from the hopper into a weighing hopper in accordance with the weight per barrel listed on the job ticket. The parts are then dumped into a plating barrel, and a plating cycle is set up by means of a mechanical programming device.

Although the machine has 21 stations, variations are needed at only eight stations in order to provide plating flexibility. The programming device consists of eight vertical flags mounted on top of the barrel carrier, *Fig.* 3, which can be set to allow the barrel to either enter or bypass a solution tank. At four of the eight stations, a timer can be set to control the length of dwell time of a barrel in solution. The cadmium plating solution is contained in two separate tanks so that a barrel can be programmed to pass through both tanks, to bypass one tank, or to bypass both tanks. While all other solution tanks in the system hold only one barrel at a time, each of the cadmium tanks holds five barrels.

After a barrel has been filled with the proper weight of parts and has been programmed for its specified plating cycle, it starts to cycle through the machine in concert with the other barrels in the

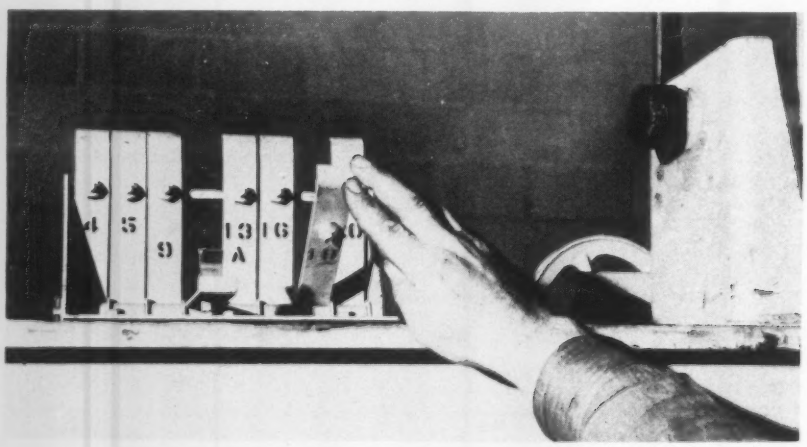

Fig. 3—Each barrel carrier is provided with a set of eight programming flags so that certain stations may be bypassed. When the flags are lowered to a horizontal position, the machine will lower the carrier into a station in a normal manner. Flags remaining in a vertical position cause the carrier to be held in a raised position and bypass the particular solution.

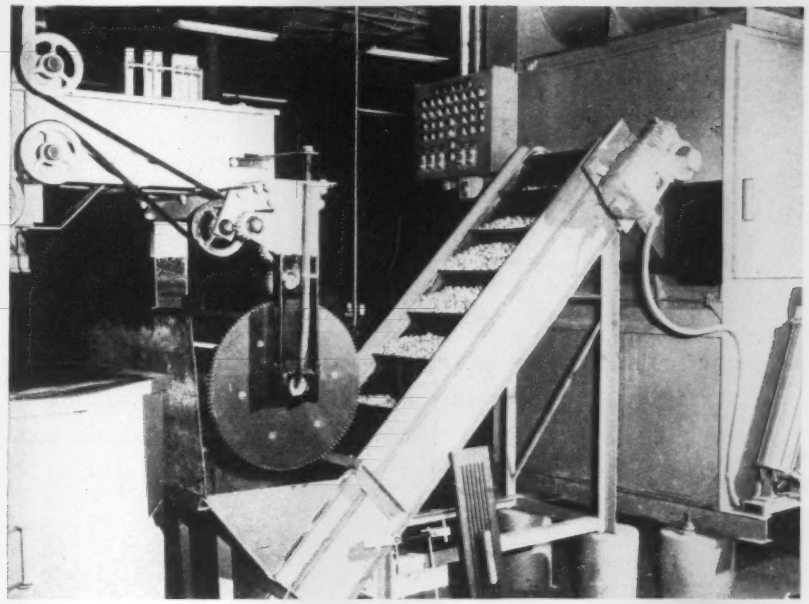

Fig. 4—At the unload station of the plating machine, the parts are dumped into an escalator conveyor and moved into an automatic dryer. Successive loads of different types of parts can be dried without mixing in four interlocked hopper-tumblers used in the dryer. After hot air drying, the parts are dumped into containers and conveyed directly back to the shipping room.

system. The barrels at each station are raised from solution, moved forward one station, and lowered into solution simultaneously. If a barrel is programmed to bypass a solution tank, the programming flag will be in a raised or vertical position and will strike a limit switch. This action causes the barrel to remain in the raised position until it reaches the next station.*

Each barrel is individually rotated by a belt drive so that tumbling rates may be changed at different stations. The tumbling speed at each station is preselected to give the best results since an ideal tumbling rate for cleaning would not be satisfactory in a plating bath.

One of the toughest problems in the design of the machine was how to increase the speed of plating in the cadmium tanks. Using existing cadmium plating techniques, a high capacity machine would require a long cadmium tank with a great number of barrels in the solution at one time. This would have required a large capital investment in equipment and considerably more floor space. Fortunately, the machine manufacturer had been working on a new cadmium solution that would allow higher current densities to be used without danger of solution breakdown from increased temperatures. The use of this solution permitted shorter cadmium tanks to be used, and the current densities per barrel were raised from a normal of 8 to 9 amperes per square foot of plating surface to 12 amperes per square foot. In order to compensate for the heat produced by the increased current, 40 tons of refrigeration continually cool the contents of the two cadmium tanks.

At the last station of the plating machine, each barrel is dumped into an escalator conveyor which carries the parts to an automatic dryer, *Fig.* 4. Four interlocked hopper-tumblers are used in the dryer so that successive loads of different parts may be dried without mixing. The parts are not transferred into the next hopper until it has emptied its load, preventing intermixed parts. The parts are rotated through two high velocity streams of hot air, and then are dumped into containers for movement back to the receiving-shipping room on a roller conveyor.

One of the tangible benefits realized by the installation of the automated plating machine is the increased ratio of work output to manhours. According to Albert E. Betteley, Bellevue vice president and general manager, the standard output in a manual barrel plating operation is about 2 to 2½ tons of parts per man per shift. On the cadmium plating line, the rate has been increased to about 9 to 10 tons per man. Only 2 men are required to operate the line—one to operate the machine and the other to perform inspection and servicing.

*For a detailed description of a similar programming system, see "Automatic Sequencing Mechanism Provides Process Selectivity," AUTOMATION, Vol. 5, No. 9, September 1958, pp. 88-90.

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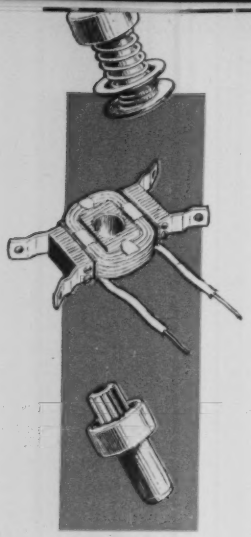


# ASSEMBLING COMPLEX DEVICES

**Most large-scale automation jobs present formidable engineering problems, but these are overshadowed by those created in automating the assembly of small electromechanical devices. Case histories show how some of these difficulties can be overcome.**

By **GEORGE L. WEISER**, Chief Process Engineer, Delco-Remy Div., General Motors Corp., Anderson, Ind.

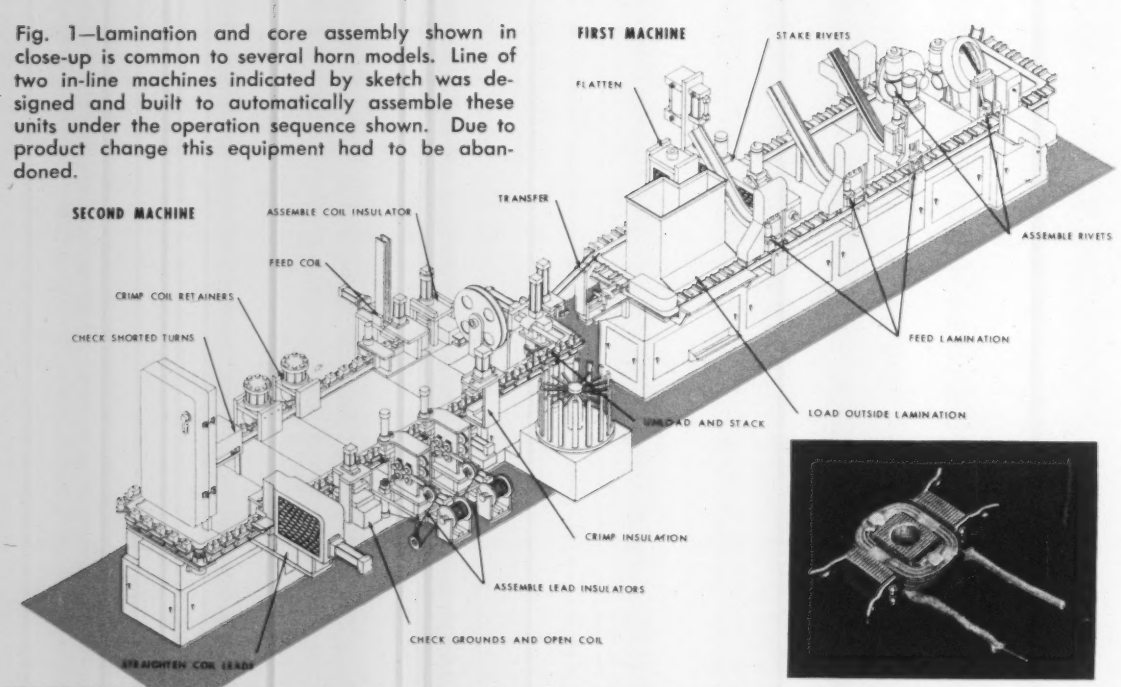



Fig. 1—Lamination and core assembly shown in close-up is common to several horn models. Line of two in-line machines indicated by sketch was designed and built to automatically assemble these units under the operation sequence shown. Due to product change this equipment had to be abandoned.



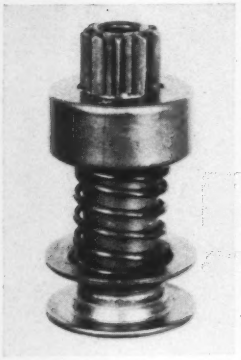
## Operation Sequence

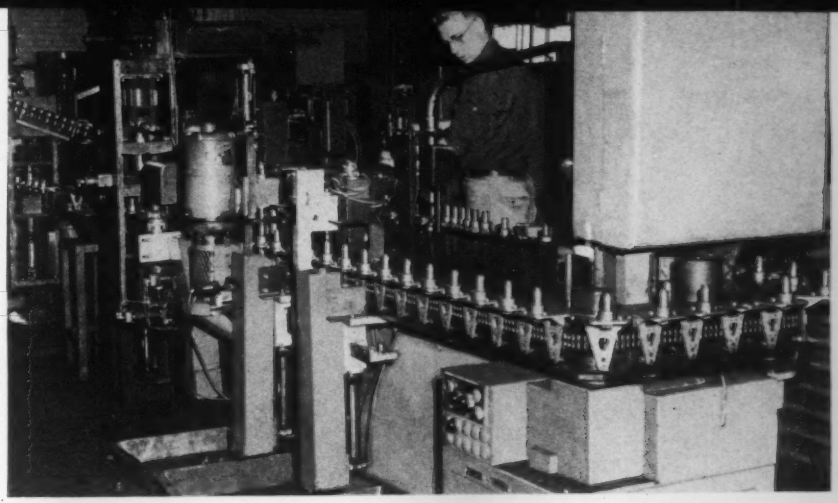
**First Machine**

1. Operator—Load outside lamination into machine nest.
2. Auto—Assemble 3 long laminations.
3. Auto—Assemble 3 long laminations.
4. Auto—Assemble 18 E—laminations.
5. Auto—Assemble 4 rivets.
6. Auto—Stake rivets.
7. Auto—Flatten lamination.
8. Auto—Transfer to second machine.

**Second Machine**

9. Auto—Place lamination assembly in nest.
10. Auto—Make and place 2 paper insulators.
11. Auto—Assemble coil.
12. Auto—Crimp 2 tangs to retain coil.
13. Auto—Check for shorted turns and eject.
14. Auto—Straighten coil leads.
15. Auto—Check for ground, open coil and eject.
16. Auto—Assemble 2 lead insulators.
17. Auto—Position 2 lead insulators.
18. Auto—Unload assembly and place in stack.





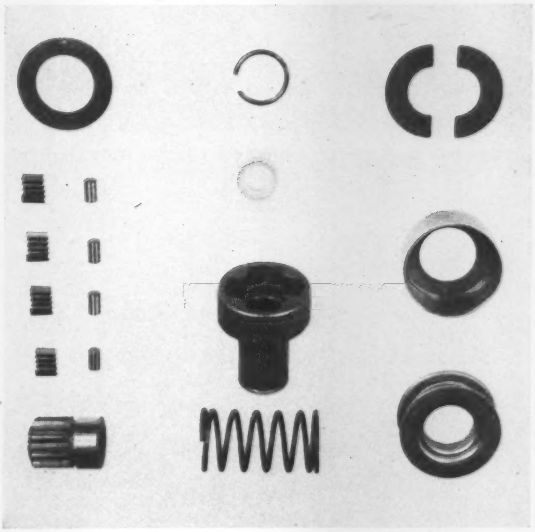


Fig. 2—Clutch assembly used on cranking motors includes parts shown. The assembly operations listed are performed on a line of two machines. The first machine in such a line is shown in the larger photograph. Job has been running for about 3 years.

**Operation Sequence**

**First Machine**

1. Auto—Assemble shell and sleeve.
2. Auto—Assemble nylon bushing.
3. Auto—Check spline and alignment.
4. Auto—Check bushing location.
5. Auto—Assemble pinion in shell.
6. Auto—Preposition shell.
7. Auto—Assemble 4 rollers.
8. Auto—Feed grease into shell cavity.
9. 4 operators—Manually assemble 4 Z-springs.
10. Auto—Assemble retainer washer.
11. Auto—Assemble 2 half-washers.
12. Auto—Assemble retainer cup.
13. Auto—Stake retainer 2 places.
14. Auto—Transfer to second machine.

**Second Machine**

15. Auto—Turn over shell assembly and place in nest.
16. Auto—Finish crimp retainer.
17. Auto—Check torque and eject.
18. Auto—Check over run and eject.
19. Auto—Assemble coil spring.
20. Auto—Assemble shift collar.
21. Auto—Assemble lock ring.
22. Operator—Unload and visual inspect.

UNDER a title as broad as "Assembling Complex Devices," a reader might expect a discussion of assembling about anything from watches to diesel locomotives. This discussion does not cover watches or locomotives. Instead, it gives a few specific examples of the successes—and failures (because we have had them too)—that Delco-Remy has experienced in assembling automotive electrical equipment. We do not feel that it is necessary to rehash a lot of generalities concerned with the old question—"To automate or not to automate." Most of us directly concerned with high volume assembly work have found that the pressure of competition leaves us with no choice.

This article is based on a paper presented at the "Third Conference on Manufacturing Automation" cosponsored by AUTOMATION and Purdue University, March 1959.

First, however, a little about our company so that you will have a better understanding of our situation in industry. We are one of the accessory divisions of General Motors. We supply ignition equipment for all new General Motors passenger cars and trucks. Included under the heading of ignition equipment are such items as generators, cranking motors, distributors, coils, voltage regulators, horns, batteries, and various switches. In addition to our General Motors customers, we supply equipment to approximately 400 customers outside the corporation. Many of these people are in the truck or tractor field, and much of this equipment is designed for heavy duty service. To handle our volume of production we have 14 plants.

In keeping with the popular concept of the auto-

mobile business, it is true that we do have high volume production on some of our products. But, we also make a great number of different models on all items in order to satisfy our customers. On one side we have a few customers who need a thousand generators or starters each day. On the other side we have many more customers who take from a dozen up to five hundred generators or starters each year.

We also have service requirements to fill. Along with current production models we must be able to run service parts for literally hundreds of past models. For example, we now have 629 active models in passenger car generators and about 780 active models in cranking motors. From these facts it is obvious that most of the final assembly operations in Delco-Remy are still performed with manual operations.

## Application Experience

Our approach to automatic assembly has been to search out the common subassemblies that many of our models use, and then build special equipment for making the subassembly. Since most of the subassemblies are relatively small in size, we have been able to utilize the basic in-line transfer-type machine for many jobs.

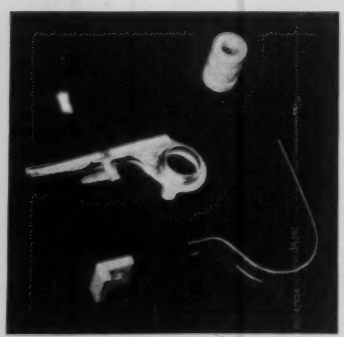
**Evaluate product design stability.** The lamination and coil subassembly for the powerplant common to all horn models is shown in *Fig.* 1. A pallet conveyor was being used for the manual assembly of this part when it was decided to study the possibility of applying automatic assembly equipment to the job. After much development work we finally arrived at a series of 18 operations that required two in-line machines, one operator, and one machine man.

The sketch in *Fig.* 1 shows the two machines as they were finally constructed. The laminations were stacked off the blanking press operation before feeding into the in-line machine. The coils were placed in a stack by the machine attendant before feeding into the assembly. The paper insulators required between the lamination and coil were an example of making-in-place from coil stock. The lead insulating material was purchased in large coils and cut to length in assembly.

We built two lines of new equipment to handle the volume required on this job, and were satisfied that we had done an outstanding job on automatic assembly. A few months later we were still taking bows when we woke up to the fact that our product was obsolete. Our customers were flirting with the competition and we were trying to sell a dead

**Operation Sequence**

1. Auto—Feed lever into machine station.
2. Auto—Check for empty station.
3. Auto—Feed insulating bushing and crimp into lever.
4. Auto—Ream bushing hole to size.
5. Auto—Assemble rubbing block.
6. Operator—Assemble lever spring.
7. Auto—Position assembly.
8. Auto—Hot upset rivet to retain block and spring.
9. Auto—Mill rubbing block height.
10. Auto—Mill rubbing block chamfer.
11. Auto—Burn off mill burr and unload.



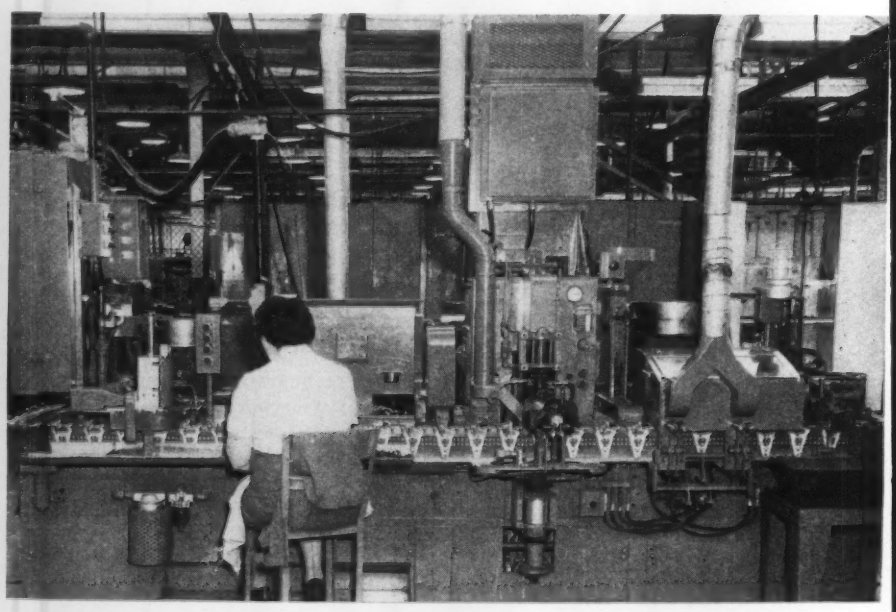
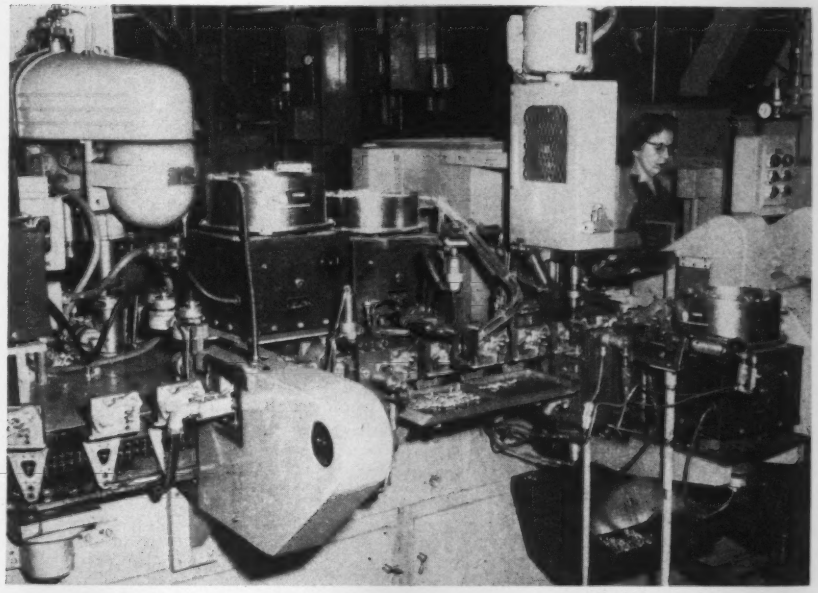
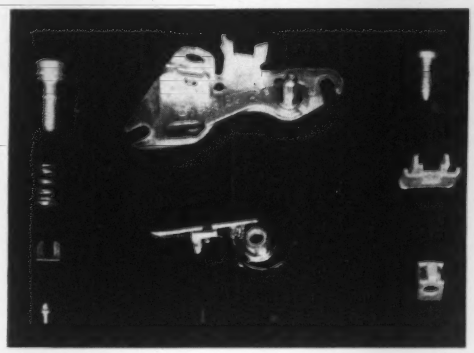
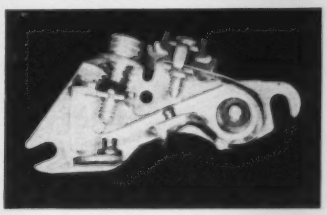


Fig. 3—Distributor circuit breaker levers are assembled from the components shown by close-up. Operations listed are performed on the in-line machine illustrated. To reduce stoppages, levers and rubbing blocks are automatically inspected to sort out bad parts.







**Operation Sequence**

1. Operator—Assemble contact support and nylon insulator in machine nest.
2. Auto—Spread apart ears on support.
3. Auto—Assemble contact point to support.
4. Operator—Grease lever shaft and assemble lever.
5. Auto—Position lever.
6. Auto—Check for contact point.
7. Auto—Weld contact point to support.
8. Auto—Assemble U-clip on nylon insulator.
9. Auto—Assemble screw into clip.
10. Auto—Assemble tension spring between ears of support.
11. Auto—Assemble adjusting screw.
12. Auto—Set tension on adjusting screw.
13. Auto—Assemble locking clip on screw.
14. Auto—Inspect for lever spring tension and reject.
15. Auto—Unload assembly.

Fig. 4—Breaker lever assembly and other components shown in close-up are put together with the operations noted to form a circuit breaker lever and support assembly. Assembly is accomplished by a combination of manual and automatic operations on the in-line machine.

horse. As a result of this situation we were forced to abandon the new equipment and undertake a complete retooling program for producing a new horn.

With the wisdom of hindsight it is now perfectly obvious that we had violated some of the cardinal rules in evaluating our new method. To quote—"Have you run a recent market survey on the product involved? Have you examined the possibilities of radical innovations in the near future? Are you planning 3 to 5 years ahead?" You can be sure that we are asking some of these questions now before undertaking any major projects on automatic assembly.

Automatic assembly of cranking motor clutches is another example where we changed from manual assembly to a series of operations performed on two

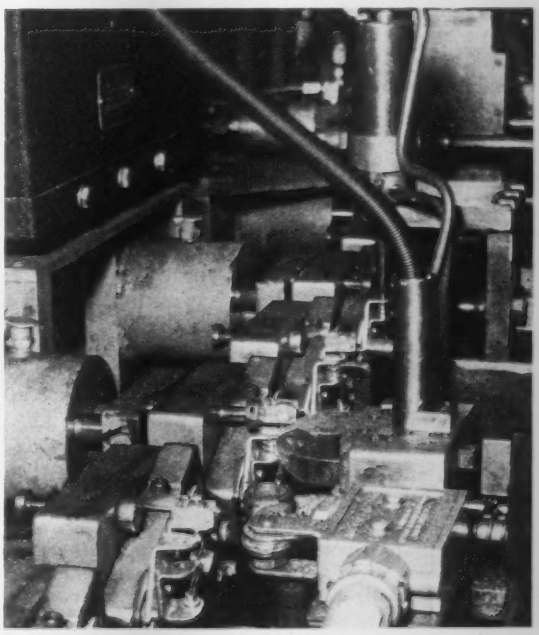
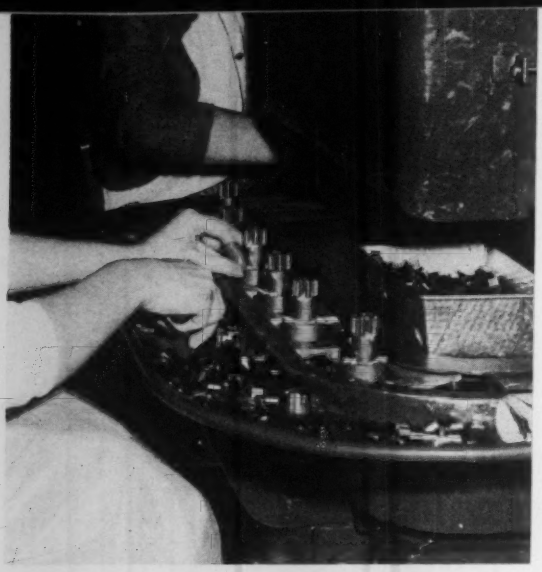


Fig. 5—Automatic station on the lever and support assembly machine performs job considered practically impossible by manual methods. A stiff tension spring is fed into place automatically.



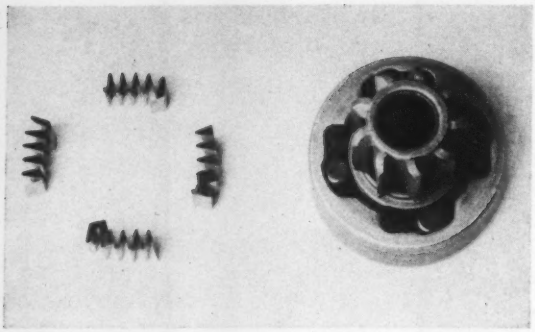


Fig. 6—View of partially-assembled cranking motor clutch shows the "Z"-springs used and their position in the assembly. Larger photograph illustrates the manual operations performed to place the springs in the unit.

in-line machines. A typical clutch assembly and a breakdown of parts in the clutch are shown in *Fig.* 2. Out of 18 parts making up the clutch, 14 are being assembled automatically.

Here again we built two lines of equipment to handle the volume, and this job has now been running for about three years. In this case you will note that most of the parts are round or symmetrical in shape, which is ideal for automatic assembly. The pinions vary in length and in the number of teeth on different models, but they can all be handled by the same feeding system.

**Sort out bad parts.** The next example concerns the automatic assembly of distributor circuit breaker levers which is done on the in-line machine shown in *Fig.* 3. The parts making up this assembly are also shown. On this job we are doing some machining operations along with the assembly operations. The lever assembly is then assembled into the contact support shown in *Fig.* 4. In this case we are assembling 9 different parts on an in-line machine. A view of several of the operations on this machine is also shown.

We believe that the last two machines are good examples of assembly of complex odd shaped parts. On the lever machine we found it necessary to run the levers and rubbing blocks through feeders ahead of the in-line machine, in order to sort out bad parts and reduce stoppages on the assembly. This has since become a standard practice on many jobs in our plant.

**Do the difficult with automation.** There are many factors to be weighed in planning automatic assembly operations on small complex parts, and quite often the direct labor saving involved on a particular operation is not as important as other factors. Sometimes the physical problems encountered demand automatic methods. As an illustration of this point we will take a closer look at two of the functions already mentioned on the lever and support assembly machine.

The tension spring that is used to maintain point setting is very stiff and is impossible to assemble manually. *Fig.* 5 shows a close-up of the operation as it is performed on the in-line machine. The springs are automatically fed into an escapement device and then compressed as they are transferred into assembly. The lock clip that is assembled onto the tension screw is also nearly impossible to assemble manually due to the size, shape, and stiffness of the part.

## ▶ Under Development

As a last example we will consider a case that is now under development. A close-up of a cranking motor clutch with the rollers and springs exposed is presented in *Fig.* 6. The Z-springs that are presently in use are also shown separately. In the de-

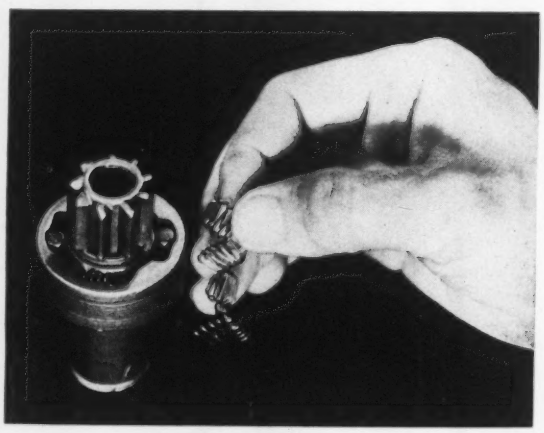


Fig. 7—To improve the quality of the product, the Product Engineering Department seeks a change in spring design to the wire forms illustrated. Because of the tangling indicated, automatic assembly of parts made on the spot seems to be the best method.

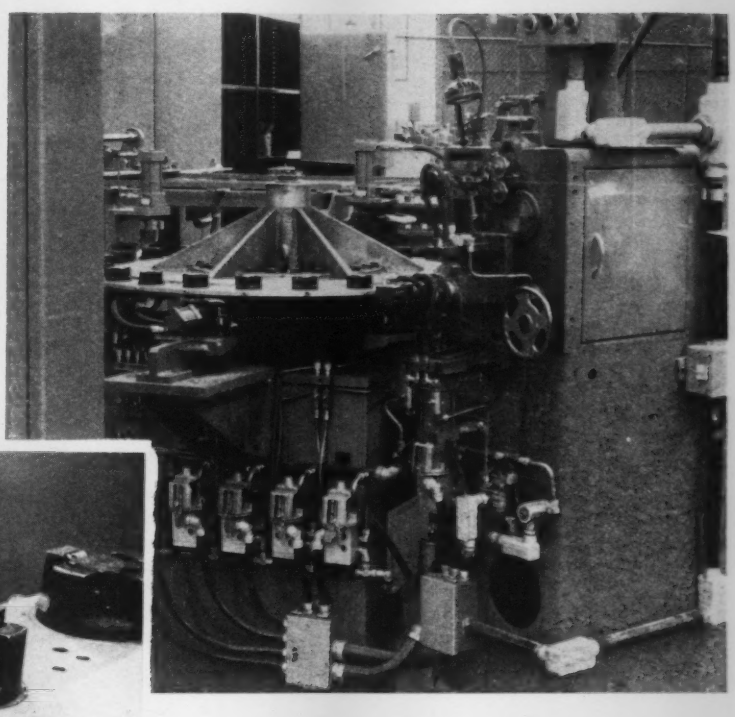
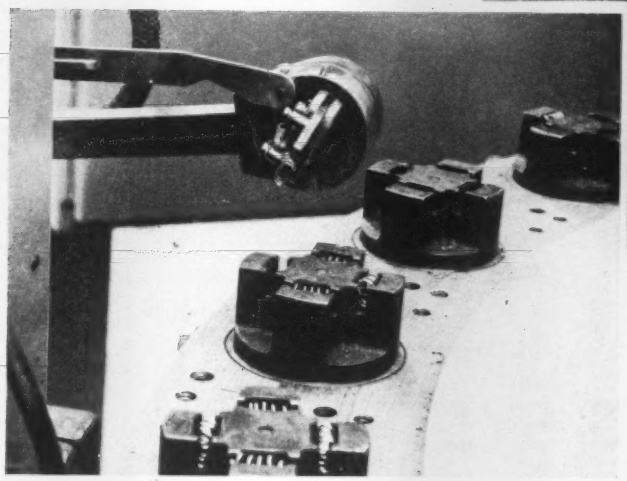


Fig. 8—This machine will automatically wind the required springs and transfer them individually to nests on an indexing dial (see close-up). A nest with four springs in place will be positioned over the clutch shell on the in-line machine and the springs will be transferred into the shell.



scription of the clutch in-line machine method previously outlined, it will be noted that the Z-springs are loaded by operators as shown in *Fig.* 6. Manual assembly has been used here due to the nature of the part. Our Product Engineering Department wants to use new springs to improve the quality of the product. *Fig.* 7 shows a close-up of the new springs and the tangling problem that is encountered in attempting to use the same assembly method. With the new spring, automatic assembly is the only method that looks reasonable.

We are now planning to wind the springs and transfer them into nests on a dial. After four springs have been placed in the nest, it will be positioned over the clutch shell on the in-line machine station. The springs will then be transferred into assembly in the shell. A view of the new dial and spring winder is shown in *Fig.* 8 with a close-up of the spring being carried down to the dial nest.

Delco-Remy has been concerned with the development and application of better assembly methods for over 30 years. During that time we have found that there is no final answer on any of our jobs. Changes in product design, new materials, an increase in schedules, or other developments can result in obsolescence overnight. This situation offers a constant challenge to improve our methods, and we have found that the most important weapon for keeping up with the task is an open mind and a willingness to try everything.

We are doing jobs today that we thought were impossible five years ago. The challenge for the future is quite clear. In the next five years we must be able to do the jobs that seem impossible today.

**can we help?**

It has been pointedly mentioned at various times that in engineering automated systems new as well as old techniques and devices may prove extremely useful. Practical results require the investigation of all available equipment that can contribute to the effective development of suitable automatic lines. Information on such equipment is presented in various departments of the magazine each month as useful data become available. To aid in obtaining detailed data for further evaluation a post card is included inside the back cover. Take advantage of this service. The Editors will be glad to help in this or any other way.

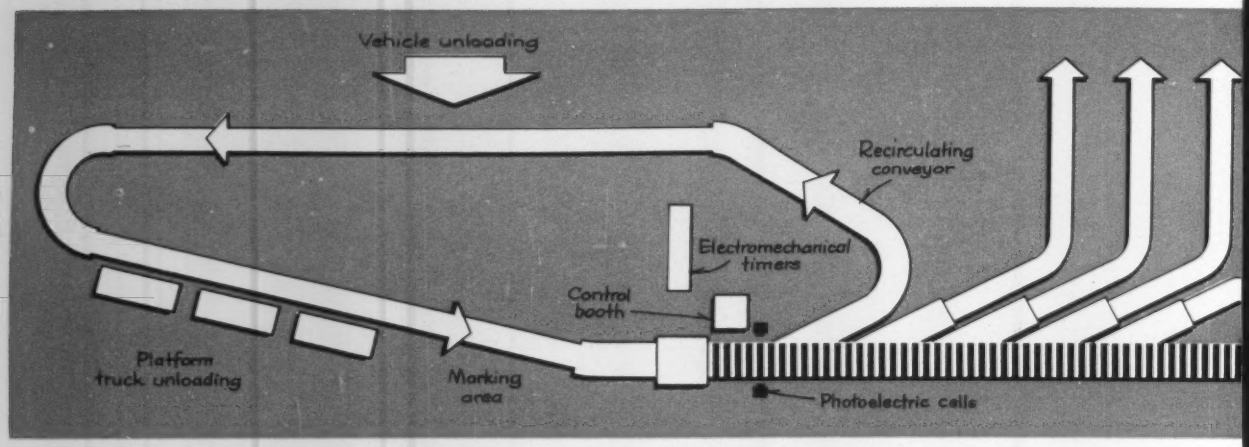



Fig. 1—Plan view shows the equipment layout of the sorting system installed in a Railway Express Agency terminal in Long Island City, N. Y. Conveyor loop on the left is used to move packages from truck unloading docks to package marking area where other packages arriving on trains are added to system. At the proper time each package is ejected from the main conveyor to one of the fourteen accumulating conveyors, or is switched to the last conveyor, far right, leading to other sorting areas.

# SELECTIVE HANDLING SYSTEM

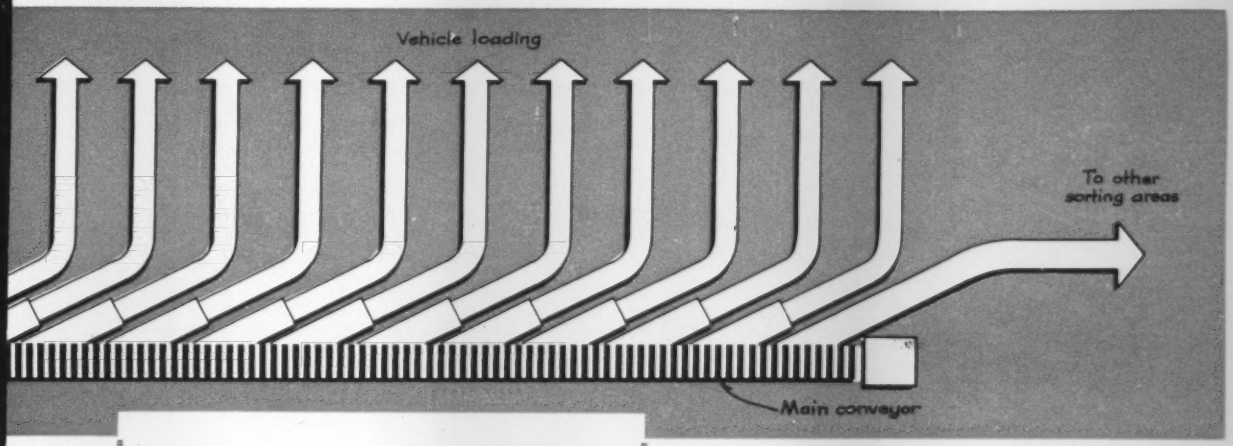
## SPEEDS PACKAGE SORTING

HANDLING AND SORTING odd-shaped packages—efficiently and speedily—has been growing into a king-size headache for various government and civil agencies such as the U. S. Post Office Dept., the railroads, and Railway Express. Not only have labor costs for manual handling of such packages been rising steadily, but also the number of packages handled has been growing by leaps and bounds. Since these materials handling agencies can envision a point in the future where manual handling methods would be swamped by the package volume, they have been developing and installing automatic handling and sorting systems to cope with the situation.

An interesting system of automatic handling and sorting has been installed in a terminal of the Railway Express Agency in Long Island City, N. Y., *Fig.* 1. Capable of handling up to 3000 individual packages per hour, this system is used to sort and route packages of all sizes and shapes to any one of 14 accumulation points, or to send parcels to other sorting areas in the building. The system was developed by Nelson Laboratories Inc. in cooperation with Railway Express engineers.

Packages are manually loaded onto a powered belt conveyor and carried to a marking area, where routing operators chalk mark each piece for a specific accumulation point in the system. The packages are then conveyed up a short incline and enter the main conveyor. As they pass a control booth, *Fig.* 2, an operator reads the destination code and enters it into a keyboard.

The main conveyor is 180 feet long and 3 feet wide. Its construction provides a novel way of ejecting packages to the accumulation conveyors at the proper time. The conveyor is composed of 4-inch wide aluminum slats supported by a roller chain. The bottom of each slat is equipped with two supports, between which is held an extruded bar that can be slid in and out of the supports. Protruding up between the slats and rigidly affixed to the sliding bar is a triangularly shaped piece called a boot, *Fig.* 3. When a package has been conveyed opposite its proper accumulation conveyor, the slid-




**Key feature of this package distribution system is the capability of handling a wide variety of parcel sizes and shapes with random spacing between items. After destination information is entered into an electromechanical memory device, the packages are conveyed to specific accumulation stations and automatically ejected by unique sliding boot mechanisms.**

ing boots are released by a control mechanism, contact the package as they move across the conveyor, and gently push the package onto the accumulating conveyor.

Using the principle of the sliding boots which are mounted on each conveyor slat in the system, it can be seen that an effective sorting system is possible by releasing the boots at the proper time. Two pieces of intelligence are necessary in order for a control system to accomplish this—one is the station number, 1 through 14, at which the package is to be removed, and two is the number of boots that must be released at the proper station. These data are entered into the control system as the package enters the main conveyor. Immediately following entry of the destination code into the keyboard, the package passes in front of a vertical bank of eight photoelectric cells which are electrically connected so that the interruption of any one light beam will actuate a relay in the control system. Regardless of how the package is lying on the conveyor, the photoelectric system will indicate all the slats between the leading and trailing edges of the package.

## Electromechanical Memory System

The two pieces of data—the slats occupied by the package and ultimate package destination—are then transmitted to the heart of the control system, a Syncro Timer furnished by Pratt & Whitney Co. Inc.* This device, *Fig.* 4, contains 10 wheels,

*A. S. Burgoyne — "Synchronizing Sensing And Processing." AUTOMATION, Vol. 3, No. 9, September 1956, pp. 49-53.

Fig. 2—Operator at the control booth reads the chalk-marked destination on each package and enters the data into a keyboard. This action initiates a circuit to the proper pin-setting solenoid of the mechanical timing device. As the package then passes the photoelectric cells, a pin on the wheel of a timing device is set for each conveyor slat that the package occupies. Below the package conveyor can be seen the return loop of the system showing the cam bar that returns the sliding boots to their starting position.

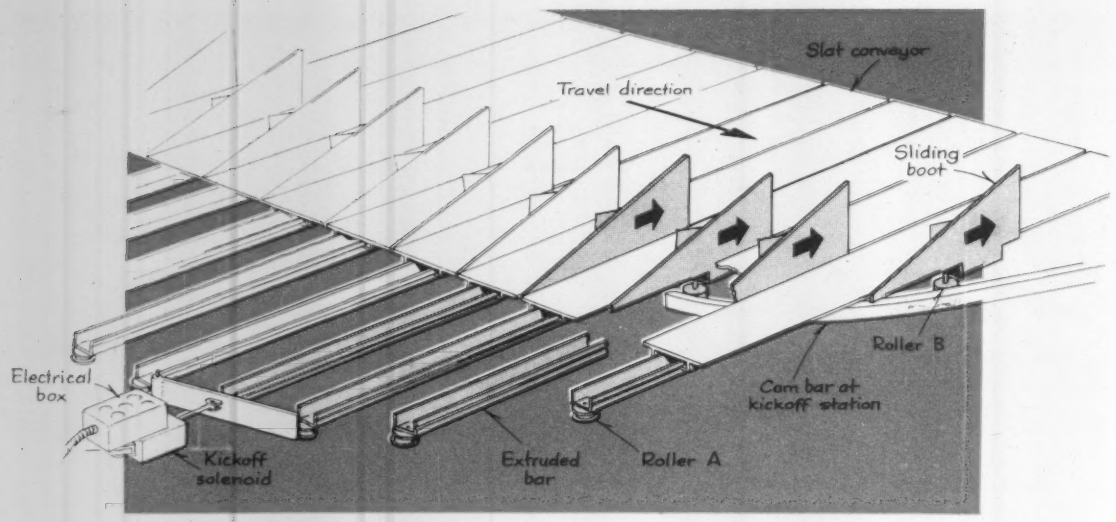



Fig. 3—Cross-sectional view of the main conveyor shows the operating details of the ejecting mechanism. When a slat reaches a desired kick-off point, an electromechanical timer actuates a solenoid, causing an arm to swivel into the path of roller *A*. As the slat continues to move forward, the arm contacts roller *A*, forcing the extruded bar holding the boot to the right. Roller *B* is forced off the roller support and engages a cam bar running diagonally across the conveyor. As the sliding boot moves to the right, it contacts the package and gently pushes it onto an accumulation conveyor.

mounted on a common shaft, which are positively driven by the main conveyor so that one complete revolution of the wheels represents a linear conveyor movement of 82 2/3 feet. Each wheel has 248 movable pins spaced around its circumference, and each pin is used to represent one 4-inch wide slat on the conveyor. Therefore, by moving a particular pin in a wheel so that it projects past the remaining pins, the pin can be used to actuate a limit switch which, in turn, can energize a solenoid, releasing a particular boot against a package.

Since each pin can be projected from either side of the circumference of a wheel, two separate control sequences can be triggered from each wheel, providing 20 control sequences in all. Eight control sequences on four of the wheels are used to control the first eight kick-off points which are within 82 feet of the zero reference point at the photoelectric cells. However, since a cam device automatically resets projected pins during each com-

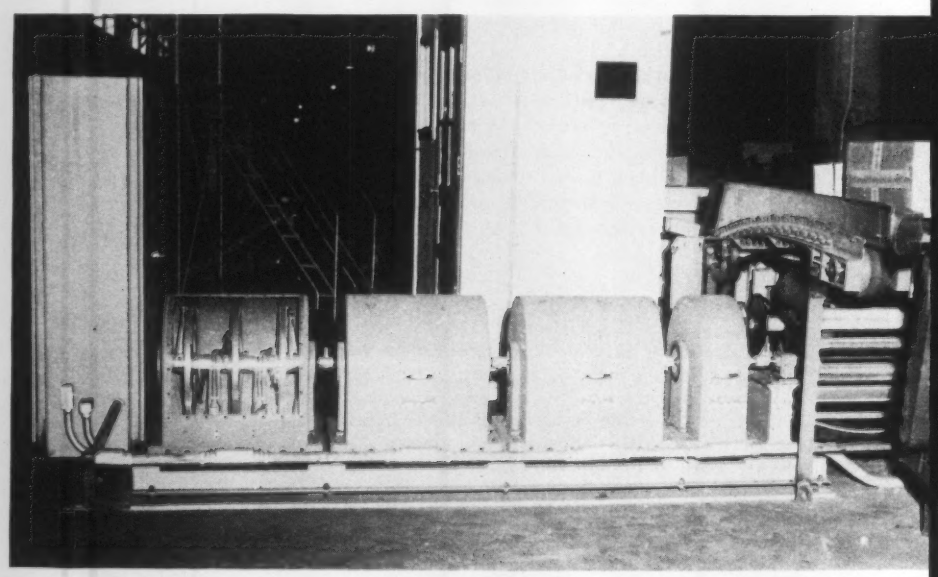


Fig. 4—This timing device is used to mechanically time the activation of the proper number of sliding boots needed to eject a package off the main conveyor. Timer at the left with the cover removed shows three of the ten timing wheels used in the system. Each wheel has 248 movable pins spaced around its circumference. As the package passes the photoelectric cells, a pin-setting solenoid on the proper wheel displaces a pin for every conveyor slat that holds the package. Later, when the package reaches the proper kick-off point, the displaced pins energize the package ejecting mechanism.

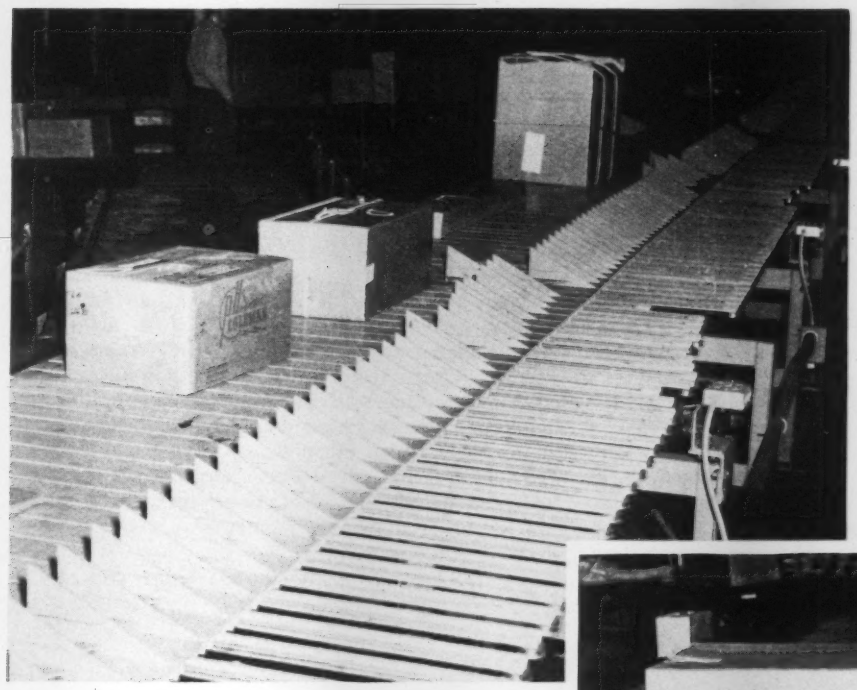
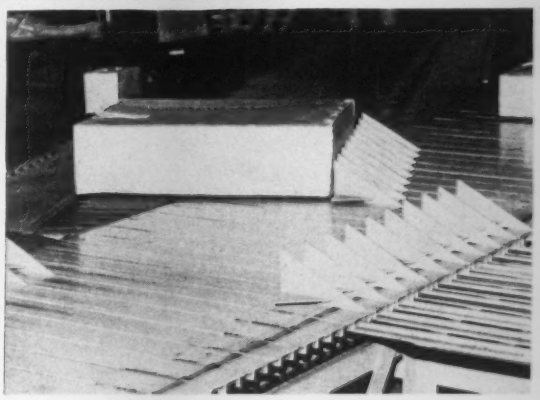


Fig. 5—In this view of a kick-off station, the kick-off solenoid has just released nine sliding boots to remove the leading large package marked "D". The solenoid then skipped two sliding boots and is now releasing additional boots to remove the second package, which is destined for the same accumulation conveyor. As the boots are moved across the conveyor, they will form a diagonal line as shown in the inset so that the package is turned to enter the accumulating conveyor squarely.



plete revolution of a wheel, a cascade of two control sequences is required to remove packages at each of the six remaining stations which are over 82 2/3 feet from the zero reference point.

When the operator reads the chalk-marked destination of a package and presses a key for a given kick-off point, he completes a circuit between the photoelectric units and a pin-setting solenoid on one of the Syncro Timer wheels. Then, as the package breaks the light beams of the photoelectric units, the pin-setting solenoid is actuated and displaces a series of pins on the timing wheel. The solenoid is de-energized when the package leaves the light beam. Since each displaced pin represents one slat on the conveyor on which a part of the package is lying, the wheel serves as a mechanical memory to hold the information until the package reaches the proper kick-off point.

The slat conveyor then carries the packages past the 14 accumulating conveyors at a speed which is variable from 100 to 300 feet per minute. At the same time, the timing wheels are being rotated at a speed which is in direct ratio to the linear speed of the conveyor. When a package nears its kick-off point, the displaced pins on the wheel approach a limit switch, mounted on an adjustable arm, which has been set to actuate the package kick-off boots. When a displaced pin actuates the limit switch, a solenoid at the kick-off station pushes the sliding bar, to which a sliding boot is affixed, off a support. A roller beneath the slat contacts a cam bar and causes the boot to move across the conveyor, *Fig.* 5. As successive boots move across the conveyor, the package is turned toward the accumulating conveyor and ejected from the slat conveyor. As soon as the package clears the slat conveyor, it rides down a gravity roller conveyor until it is stopped by previously sorted packages.

In cases where the kick-off point for the package is more than 82 2/3 feet from the zero reference point, that is, the last six stations, a different sequence of events occurs. When the particular timing wheel has almost completed one revolution and is about to be reset, the limit switch for that wheel is actuated by the pins and transfers the pin settings to a second pin-setting solenoid. This wheel then revolves until the package reaches the kick-off point, at which time the pins actuate the boot release solenoid in the normal manner.

Any packages remaining on the conveyor after the fourteenth station is passed are automatically diverted to a powered conveyor leading to other sorting areas. All sliding boots that have not been used are then caused to move across the conveyor, and the slats return to the start position by moving underneath the sorting stations. At the starting end of the conveyor, a master cam causes the sliding boots to be retracted to their starting positions and lifted back onto their supports.

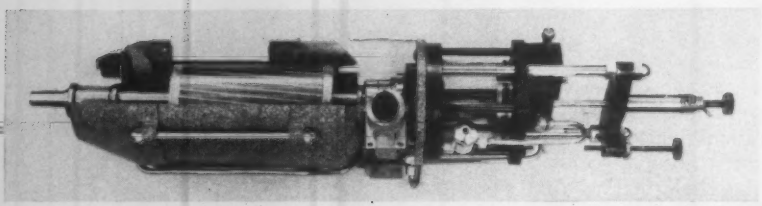
When one of the accumulation conveyors is filled,

**SELECTIVE HANDLING SYSTEM**

or if a package jams the station, a set of feelers beneath the conveyor actuates an anti-jam circuit so that no other packages can be sent to that branch until the jam is cleared. The anti-jam circuit prevents the operation of the pin-setting solenoid on the Syncro Timer wheel for the jammed station, and diverts the packages onto a recirculating conveyor loop as soon as they pass the photoelectric units. At the same time the circuits cause an alarm to sound and flash a numbered light over the conveyor to indicate which branch is filled.

Another interesting feature of the system is the use of the vertical array of 8 photoelectric cells at the zero reference point of the system. This setup was used so that an irregular shaped object, such as an exhaust pipe, would properly register over its entire length. Since one part of the object could be off the conveyor as it passed a single photoelectric cell, causing a make-break-make scanning sequence, the stacked array of photoelectric cells was used in the system. For example, if the flow of packages was heavy enough so that the keyboard operator had pressed a second key for a following package, a make-break-make sequence would automatically transfer some of the boot control signals to the timing wheel of the second package. This is prevented by the stacked array of photoelectric cells since breaking the light beam of any one cell will actuate the pin-setting circuit.

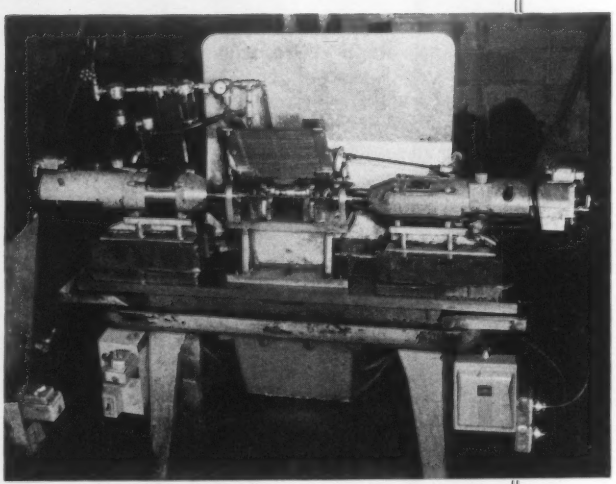
Main advantages of this type of handling and sorting system are its simplicity and its ability to handle high density flows of packages. Where other sorting systems require that a fixed distance, such as 3 feet, be maintained between the centerlines of adjacent packages, this system can handle a stream of packages which are practically lying end to end. The simple but effective mechanical memory device and the absence of electronic components from the circuit lead to easy maintenance and high reliability of the system.



## MODULAR MACHINE COMPONENT

BECAUSE of their relatively low cost and high degree of adaptability, individually mountable drill heads offer one of the best answers to today's machine shop need for flexible equipment that can change with production requirements. As a modular component, drill heads with the capability of both feed and rotational control can be used to develop many automatic processes. Such equipment can drill, ream, tap, countersink, counterbore, center, end mill, hollow mill, face or flare tubes, chamfer, deburr, burnish, and polish—to mention but the obvious.

A modular drill head manufactured by Bedford Gear & Machine Products Inc., contains unique features that make it a valuable automation tool. As shown in the cutaway model, the unit includes a tool spindle that is integral with the rotor of the electric motor that supplies rotary power. The entire spindle-rotor assembly moves relative to the stator of the motor under pneumatic cylinder actuation in obtaining tool feed. Operation of the pneumatic cylinder, serviced by factory air lines, is controlled by means of a solenoid actuated 4-way valve. Feed rate of the tool is controlled by an adjustable metering valve in a closed hydraulic circuit that buffers the driving action of the pneumatic cylinder. Adjusting screws permit the depth of feed to be set to an accuracy of 0.0005 inch. Varying according to frame size (either a nominal 6 or 8-inch diameter), a standard adjustable stroke of up to 4 inches is obtainable.

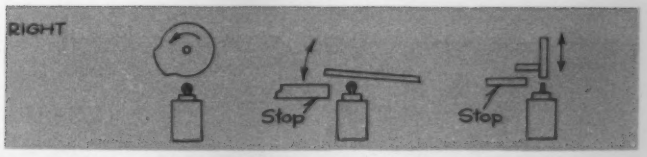


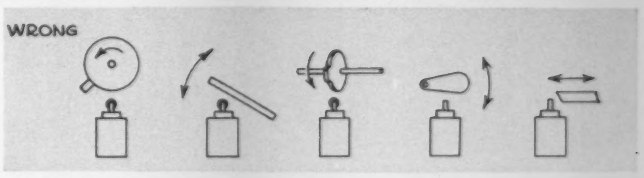
As an example of the unit in use, the illustrated machine was developed using two of the drill heads. At the Cleveland plant of Commercial Induction Inc. the units burnish the ends of valve push rods. Using a conventional 3-roll head, the automatic feeding and sequencing machine produces burnished rods at the rate of 20 per minute. As shown in the illustration, auxiliary control signals can be obtained by the use of limit switches that are actuated by the moving parts of the drill heads.

**Third and concluding part of a series, AUTOMATION presents the final portion of NEMA Publication IC 3-1959, "Precision Snap-Acting Switches." This section completes the suggestions for proper application of industrial limit switches covered by NEMA Authorized Engineering Information 1-13-1959, comprising Part 2 of IC 3-1959.**

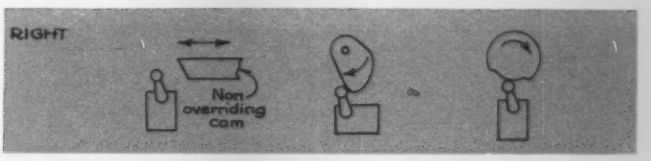
# APPLYING INDUSTRIAL LIMIT SWITCHES

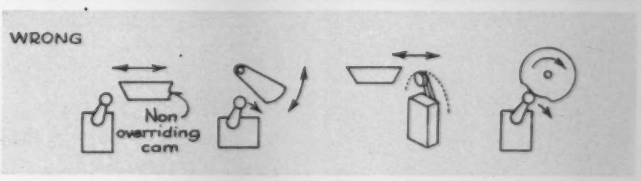
IC 3-2.10. For limit switches with pushrod actuators, the actuating force should be applied as nearly as possible in line with the pushrod axis.



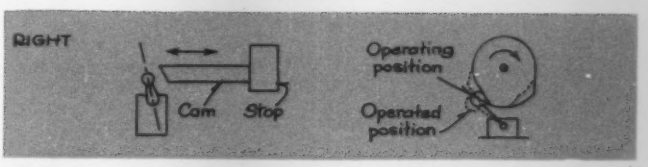



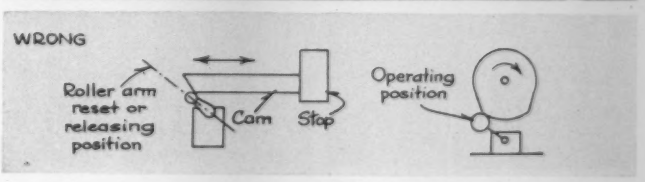

IC 3-2.11. For limit switches with lever actuators, the actuating force should be applied as nearly perpendicular to the lever as practical and perpendicular to the shaft axis about which the lever rotates.

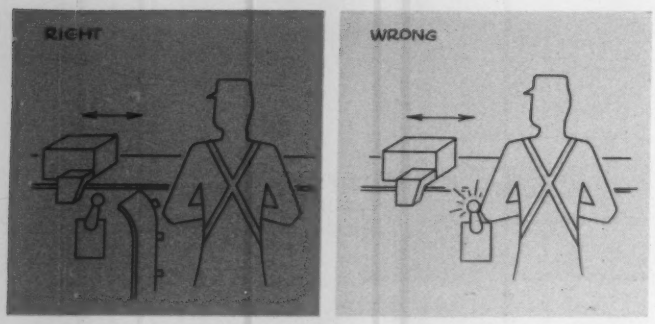


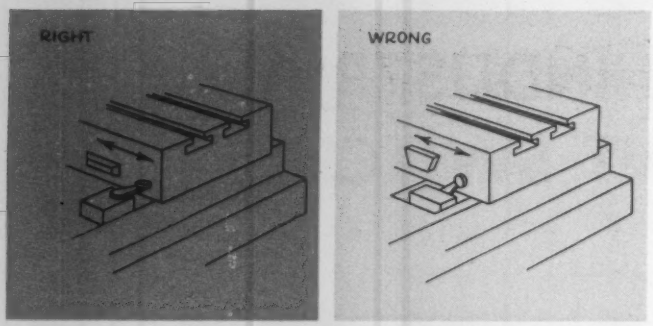

IC 3-2.12. A limit switch actuator must be allowed to move far enough for positive operation of the contacts.



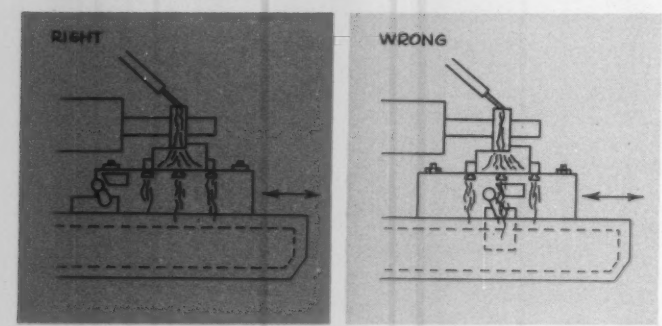





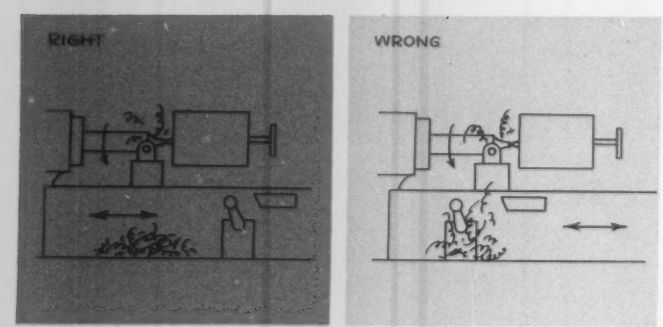

IC 3-2.13. Limit switches should be mounted in locations which will prevent false operation by normal movements of operator or machine components.



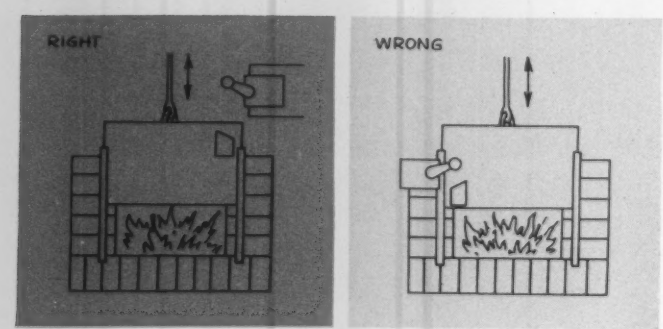

IC 3-2.14. Limit switches should be mounted rigidly and in readily accessible locations, with suitable clearances to permit easy service and replacement when necessary. Cover plates should face the maintenance access point.




IC 3-2.15. Limit switches should not be submerged in or splashed with oils, coolants, or other liquids unless specifically designed for such service.




IC 3-2.16. Limit switches should be placed in locations where machining chips do not accumulate under normal operating conditions.




IC 3-2.17. Limit switches should not be used in locations where temperature or atmospheric conditions are beyond those for which they have been specifically designed.

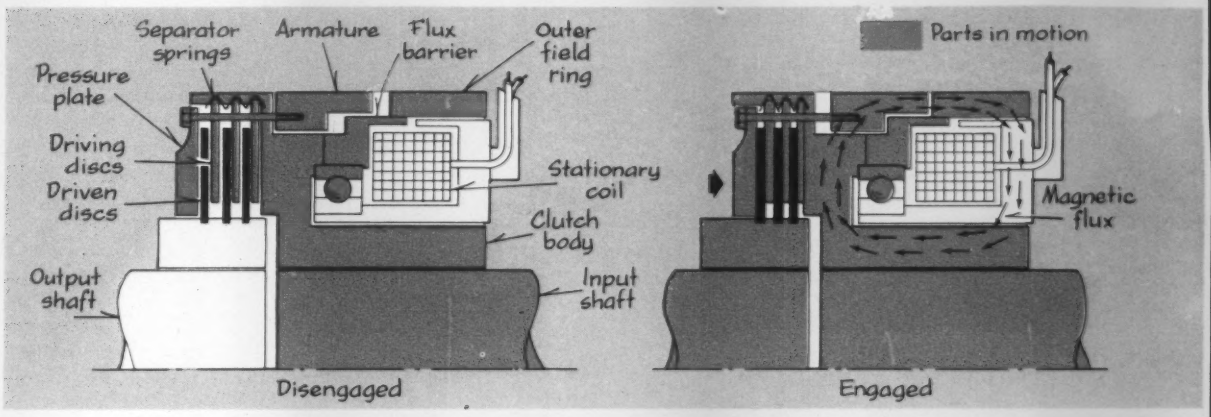



Fig. 1—Partial cross-sectional views of multiple disc electromagnetic clutch illustrate the operating method of a stationary coil unit built by Fawick Corp. When no current flows through the coil, the separator springs spread the discs apart and no power is transmitted from input to output shafts. Current through the coil sets up magnetic flux that moves armature toward outer field ring. Pressure plate attached to armature compresses disc stack, and input shaft is mechanically linked to output shaft.

## APPLYING MAGNETIC MULTIPLE DISC TYPE

# ELECTRICALLY CONTROLLED CLUTCHES

**Need to engage and disengage one shaft from another under electric control is found in many machine configurations. A popular solution is the use of electromagnetic clutches of the multiple disc type. The author discusses selection factors and applications of such units.**

By **ALEX M. STEWART Jr.**, Manager, Magnetic Sales and Engineering, Fawick Corp., Cleveland, Ohio

MECHANICAL POWER transmission components that have been attracting increased attention among machine builders are the electromagnetic clutches. With increasing demands for more automatic cycling and faster cycling rates, the use of electrically controlled clutches has grown rapidly. Several features which lead to increased application of electromagnetic clutches in automatic machines are noted in TABLE I.

Though there are several basic types of electromagnetic clutches, one of the most popular is the multiple disc variety. Clutches of this type use interleaved discs connected to driving and driven members. Flow of electric current through an actuating coil sets up a magnetic field which is used to force the discs against one another and effectively lock the driving and driven members together. These clutches generally are compact, simple to control, and easy to install since they come from the factory completely assembled.

## ELECTRICALLY CONTROLLED CLUTCHES

The operation of one particular design of electromagnetic multiple disc clutch is illustrated in *Fig.* 1. This illustration represents an SC unit built by Fawick Corp. In this unit, a stationary coil is mounted in the clutch body on a ball bearing. Body, armature, outer field ring, and coil housing form a magnetic path around the coil and flux barrier. When the coil is energized, the flux flow through this circuit pulls the armature toward the outer field ring and pulls the pressure plate toward the body. This compresses the disc pack and engages the clutch.

The disc pack in this unit is composed of steel driving discs and alternate sintered bronze driven discs. Compression of the pack causes the driven discs to make contact on both sides with driving discs. When current to the coil is cut off, the magnetic field decays, and springs between the driving discs push them away from each other. The driven discs are thus free to idle.

**TABLE I**

**Features of Electromagnetic Clutches**

1. Fast engagement and disengagement
2. Smooth, shockfree acceleration and deceleration
3. Low inertia
4. Easy to jog for machine setup
5. Small space requirement
6. Available for wet or dry use
7. Operation electrically controlled
8. Easily adjustable, precise torque control
9. Power to operate readily available

### Application Areas

The functions for which magnetic clutches are used on automatic machines can be grouped in four general classes: Starting, running, cyclic, and torque-limiting.

Starting applications involve engaging the clutch under load. This type of application is commonly found with conveyors, feeders, and indexing or positioning units. Smoothness of engagement with magnetic clutches is particularly helpful in controlling shock.

The table drive for a surface grinder is one example of a starting application. The reversing of the table drive is performed by two electromagnetic clutches. A smooth shockfree operation is obtained. Stroke can be varied from 3 to 24 inches with 60 to 100 reversals per minute on short strokes.

Running applications are those in which the load is applied after the clutch is engaged and the driven member has attained operating speed. This type of use is most common with machine tool elements such as a lathe spindle where the spindle is set in motion before the tool is brought into contact with the work.

Three electromagnetic clutches are used in a running type application on the tape-controlled machine illustrated in *Fig.* 2. These clutches control the spindle drive on this machine. Normally the desired clutches are engaged before the tool carried by the spindle comes into contact with the workpiece, and are not disengaged until the tool leaves the work.

Cyclic applications are those which use both starting and running characteristics of magnetic clutches.

Torque-limiting applications use the nearly straight-line relationship between coil voltage and torque in electromagnetic clutches to advantage. The amount of torque applied to a driven member can be limited through controlled clutch slippage.

An example of a wet clutch used to control torque is incorporated in a hose assembly machine. Accurate torque control is needed to prevent over-tightening of hoses and fittings. Torque is controlled by regulating the current in the clutch coil. When changing hose and fitting size, the operator repositions a rheostat control dial for the desired torque setting. The electromagnetic clutch delivers power to assemble hose and fitting, then slips when the assembly has been correctly tightened.

### Selection Factors

Among the factors which must be considered when choosing an electromagnetic clutch for a particular application are the following: 1. Torque. 2. Heat dissipation. 3. Environment. 4. Space available. 5. Type of controls.

In general, the most important of these is torque. However, particularly for applications involving high rates of cycling, the final choice is usually based on heat dissipation. Consideration of heat dissipation involves a combination of speed, horsepower, cyclic rate, and inertia. Often it is found that a clutch which is adequate for the torque requirement is too small to dissipate the amount of heat that will be produced.

Environmental conditions will govern to a great extent the choice between using a wet or dry type clutch. The amount of space available and type of controls influence the selection of clutches to be used. Where a great deal of space is available, almost any kind could be selected; but where space is limited, as in a gearbox, the unit with the most favorable space versus torque ratio would be required.

**Calculating Torque Requirement.** Where the starting (pickup) torque requirement for a particular application is not known, it may be calculated by the following formula:

$$T = \frac{5250\ K\ Hp}{N}$$

where $T$ is starting torque, pound-feet; $Hp$ is power required, hp; $N$ is minimum operating speed of the shaft, rpm; and $K$ is a service factor.

The service factor is based on inertia of parts to be accelerated, cyclic rate, and shock or peak load to which the clutch may be subjected. Examples of $K$ values are 1 to 1½ for a fan application, with values as high as 5 to 7 for a diesel engine coupled to a refrigerator compressor. An average value of 2 or 3 is used in most applications involving electric motors.

**Calculating Heat Dissipation.** The amount of work a clutch can perform in a specified period of time is governed by its ability to dissipate heat. Since work is a function of inertia, speed, and frequency of application, the total energy to be dissipated as heat in a specific application is calculated by the formula:

$$E = 1.7\ WR^2 \left(\frac{N}{100}\right)^2 F$$

where $E$ is heat generated in the clutch, foot-lb per minute; $WR^2$ is inertia of the load, pound-feet squared; $N$ is speed of the shaft, rpm; and $F$ is the cycling rate, applications per minute. The cycling rate $F$ is sometimes expressed as cycles per hour, in which case, $E$ is found in foot-lb per hour.

**Selecting Clutch Size.** When torque and heat dissipation for a specific application indicate the same clutch size, the proper clutch size is the one indicated by both considerations. However, such agreement is often not the case, and where the size requirements differ, the larger must be chosen. Such a selection has additional merit in that a larger clutch will not be worked to as high a proportion of its capacity as a smaller clutch, therefore the larger clutch will provide longer wear life.

**Wet or Dry?** Multiple disc clutches are available for wet or dry operation. In wet operation, the clutch is immersed in, dipped in, or sprayed with oil or some other suitable lubricant. In dry operation, the clutch plates are kept free from lubricant of any kind. Some clutches may be used in either wet or dry applications without alteration.

Choice between operating a clutch wet or dry is usually dictated by the application. If the clutch is to be located in a gearbox which is normally filled with oil, it is undoubtedly more economical to use a wet clutch rather than to try keeping oil out by use of an oiltight housing. Heat buildup and dissipation are better controlled in a wet clutch, providing more consistent friction and more accurate control of torque output. Wet clutches also have an advantage when an installation is located in a machine in such a manner that it is difficult to reach. Wet clutches are good for such locations because they require less servicing than dry clutches.

In a given space, a dry clutch will provide a greater torque than a wet clutch because of a greater coefficient of friction between the plates. Thus, a dry clutch is often preferred in a reasonably dry environment because it may save space. When using an ordinary dry clutch, precautions must be taken to insure that oil will not be deposited on the friction plates. Oil on the plates allows the clutch to slip, and, if left engaged, to be severely damaged. When a clutch designed for both wet and dry operation is used dry, it should be of a size slightly larger when there is a possibility of oil contamination.

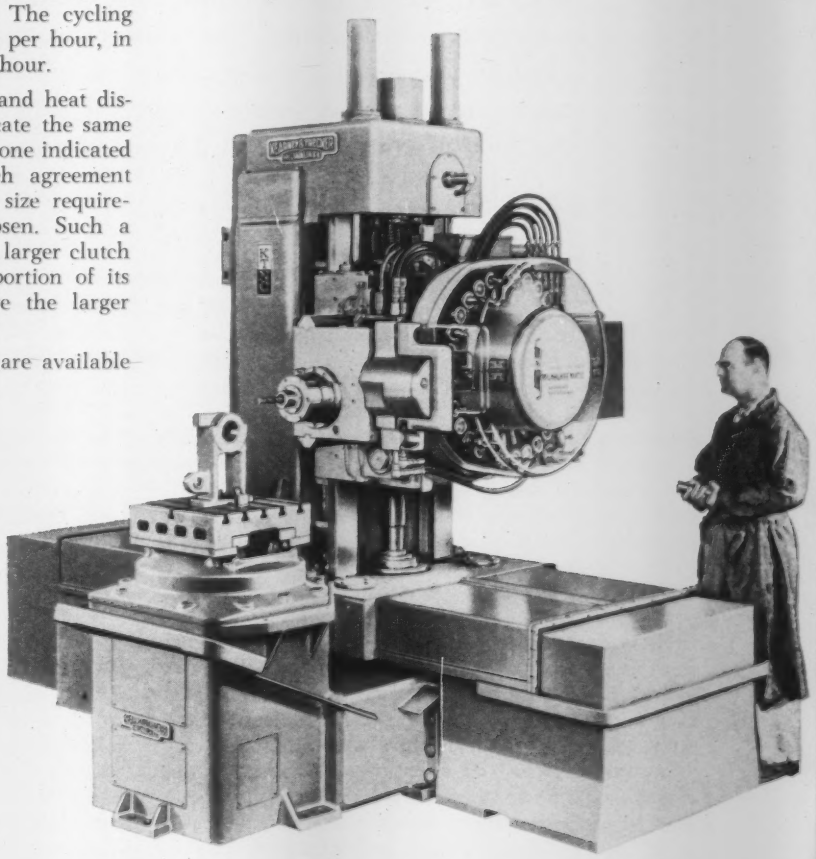


Fig. 2—Versatile multioperation machine built by Kearney & Trecker Corp. applies three electromagnetic clutches to control the spindle drive. Spindle drives such as this are usually running type applications in which the load is applied after the clutch has been engaged and the output shaft has attained operating speed.

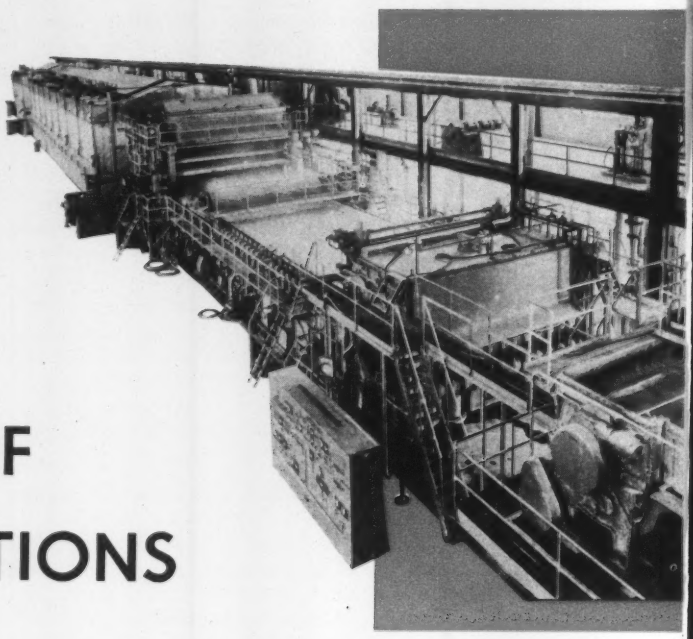


Fig. 1—This paper machine is used to manufacture enamel printing paper at the Biron Div. of Consolidated Water Power & Paper Co. To control the final pH of the paper web, continuous measurements of pH are made by electrodes immersed in the stock slurry feeding into the headbox which is located directly above the control panel. Liquid alum is automatically added to the slurry to adjust the pH value of the solution to desired tolerances.

# CONTINUOUS pH CONTROL OF PROCESS SOLUTIONS

**Continuous control and correction of either the acidity or alkalinity of solutions is a necessity in many industrial processes in order to meet product specifications. Such control is exercised by measuring the hydrogen ion concentration, or pH factor, of a solution and automatically adding chemicals to maintain the solution in an acidic, basic, or neutral state. Direct and indirect methods of continuous pH control are discussed in this article.**

FOR EVERY TON of paper it manufactures, the paper industry consumes approximately a quarter of a ton of chemicals. For example, the industry uses 90 per cent of the North American production of saltcake, 75 per cent of the alum, 60 per cent of the clay, 20 per cent of the rosin, and 16 per cent of the chlorine. Some of these chemicals are acid and some are basic, but, wherever they are used in solutions, their concentrations must be accurately controlled in order not to affect the quality and physical characteristics of final paper product.

Since the degree of concentration of an acid or base is not a good measure of its quality or effectiveness for a given function (see box), industry controls acidity and alkalinity by measuring the hydrogen or hydroxyl ion concentration of a solution, and states this measure as a pH factor. In the pulp and paper industry, pH control is used for many processes such as digesting or "cooking" pulp, bleaching pulp, treating water, and setting size and dyes in paper manufacture. One of the widest uses of pH control is monitoring headbox feedstocks during the actual manufacture of paper on a paper machine. Continuous control of pH is of great importance in this operation because final paper properties such as sizing efficiency and sheet color are influenced to a large extent by the feedstock pH. Correct control of pH improves the drainage of water through the stock on the paper machine wire, and close control of pH reduces the amount of iron-free alum required for fine paper, providing substantial savings in chemicals.

## Measuring Weak Solutions

At the Biron Div. of Consolidated Water Power & Paper Co., a direct method of continuous pH control is used to maintain stock slurry within desired tolerances in the head box of a paper machine that produces enamel printing papers. The block-long paper machine, *Fig.* 1, has increased production of this type of paper by about 50,000 tons per year. This machine consists of eight basic parts, four com-

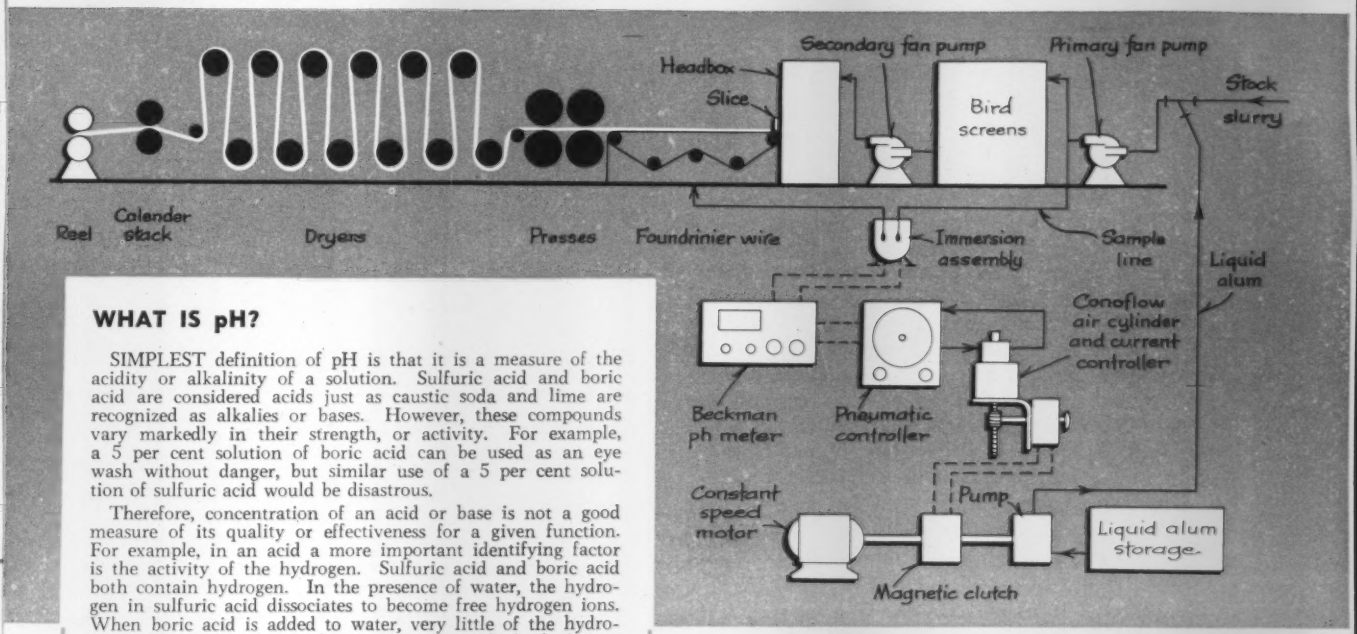



Fig. 2—Diagram illustrates the control system for correcting the pH of the stock slurry. The pH variations are detected in the stock flow to the headbox by the immersed electrodes and pH meter. This meter transmits an electrical signal to a controller which converts the signal to a pneumatic signal for operating the current controller. The current controller in turn varies the output speed of a magnetic clutch in proportion to the pneumatic impulses it receives. A constant speed motor is connected through the magnetic clutch to a pump which feeds liquid alum to the stock slurry.

## WHAT IS pH?

SIMPLEST definition of pH is that it is a measure of the acidity or alkalinity of a solution. Sulfuric acid and boric acid are considered acids just as caustic soda and lime are recognized as alkalies or bases. However, these compounds vary markedly in their strength, or activity. For example, a 5 per cent solution of boric acid can be used as an eye wash without danger, but similar use of a 5 per cent solution of sulfuric acid would be disastrous.

Therefore, concentration of an acid or base is not a good measure of its quality or effectiveness for a given function. For example, in an acid a more important identifying factor is the activity of the hydrogen. Sulfuric acid and boric acid both contain hydrogen. In the presence of water, the hydrogen in sulfuric acid dissociates to become free hydrogen ions. When boric acid is added to water, very little of the hydrogen is liberated as free hydrogen ions. Instead, the hydrogen ions remain relatively inert in the undissociated molecules of the acid. Therefore, the true measure of acidity concerns the amount of dissociated, or free, hydrogen ion concentration of a given solution.

In 1909 a Danish chemist, Sorenson, proposed that the initial letter of the French word "potenz", meaning potency or power, be called the "hydrogen ion exponent" and expressed as pH. Technically, the term pH is an expression of the negative logarithm (or the reciprocal) of the hydrogen ion concentration, and is expressed as a logarithmic index employing small numbers rather than in terms of hydrogen ions per cc, ounce, or some unit of finite weight or volume.

The pH index normally is considered to range between pH 0 and pH 14. Theoretically, it is possible to have pH values above or below these limits, but from a practical standpoint they can be ignored. The lower the pH value, the greater the free acidity, or hydrogen ion, concentration. Thus, a 5 per cent sulfuric acid solution will have a pH of approximately 0.3 while a 5 per cent boric acid solution will measure about pH 5.0. Although the hydrogen concentration of these two acids is the same, their pH values reflecting hydrogen ion concentration vary widely, permitting an accurate evaluation of their quality and effectiveness in a process.

A solution having a value of pH 7.0 is arbitrarily considered as neutral. Solutions below pH 7.0 are classified as being acidic while those above pH 7.0 are accepted as basic. However, in alkalies the pH is a measure of the free hydroxyl ions rather than free hydrogen ions. As the pH value rises within a soltuion, the concentration of hydrogen ions decreases and the hydroxyl ions increase. The product of the hydrogen and the hydroxyl ions in solution is always a constant regardless of the pH of the solution.

prising the wet end and four the dry end. Continuous pH control is concerned with the operations at the wet end which includes the head box, the slice, the Fourdrinier wire, and the presses.

Before the stock slurry enters the head box, it contains about 97 parts of water to 3 parts of paper pulp. This mixture is too heavy to be formed into a sheet so it is diluted with whitewater—water reclaimed from the Fourdrinier wire and containing minute pulp fibers—to a consistency of about 99.5 per cent water. In order to control the pH of the final sheet, pH measurements are taken and papermaker's alum is automatically added to the slurry to acidify the pulp within the desired tolerances for the particular type of paper being made.

The pH control system for Consolidated's paper machine is shown in *Fig.* 2. Immersed in a sample tank adjacent to the head box is an assembly containing reference and glass electrodes, *Fig.* 3, required for pH measurement. The glass electrode consists of a glass tube which is closed at the bottom by a membrane of special pH-sensitive glass. Immersed in a buffered chloride solution inside the glass tube is a silver coated wire which is connected by an insulated and shielded connector to a pH meter. The reference electrode is immersed alongside the glass electrode and serves to complete an electrical circuit between the pH meter and glass electrode. The reference electrode consists of a silver-silver chloride element surrounded by an electrolyte of known concentration. A small outlet in the bottom of the reference electrode allows a finite amount of electrolyte to continuously escape into the solution to be measured and form a conductive bridge between the solution and the reference element.

The exact manner by which a surface potential is

developed on the pH-sensitive tip of the glass electrode is a matter of scientific discussion. However, such a potential is developed and is directly related to the hydrogen ion concentration of the solution. The measurement is transmitted to a pH meter furnished by the Scientific and Process Instruments Div., Beckman Instruments Inc. The pH meter is connected to a pneumatic controller so that any variation in pH beyond set limits produces a pneumatic signal which, in turn, actuates a current controller. This unit governs a magnetic clutch which automatically controls the feeding of papermaker's alum to the feed stock for pH adjustment.

The alum-slurry blend is then fed to a primary fan pump where it is mixed with white water from the Fourdrinier wire pit and pumped into the bird screens. A secondary fan pump next moves the mixture into the head box where excessive turbulence is stilled and uniform fiber suspension is attained.

The slurry feeds out of the head box and onto the Fourdrinier wire through the slice, a narrow slot in the front-face of the head box. Fibers flowing onto the wire line up in the direction of flow. By jerking the wire from side to side, at the slice, the fibers can be tangled in a cross-machine direction to give various paper characteristics. Water is drained and sucked from the paper sheet as it is conveyed on the wire until the sheet is compact enough to hold together of its own accord. As the web of newly-formed paper leaves the wire, it still contains about 80 per cent water by weight. It is next processed through presses which reduce the water content to about 60 or 70 per cent. The sheet then enters the dry end of the machine for final drying and finishing.

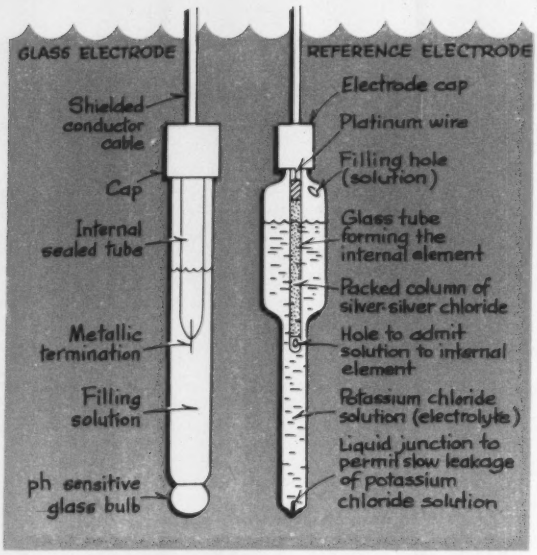



Fig. 3—Glass electrode, left, and reference electrode, right, make up the immersion assembly for measuring pH factors. The reference electrode is immersed alongside the glass electrode and serves to complete an electrical circuit between the pH meter and glass electrode.

## Measuring Strong Solutions

While most pH control problems in the pulp and paper industry are concerned with the measurement of weak acid and base solutions, other industries

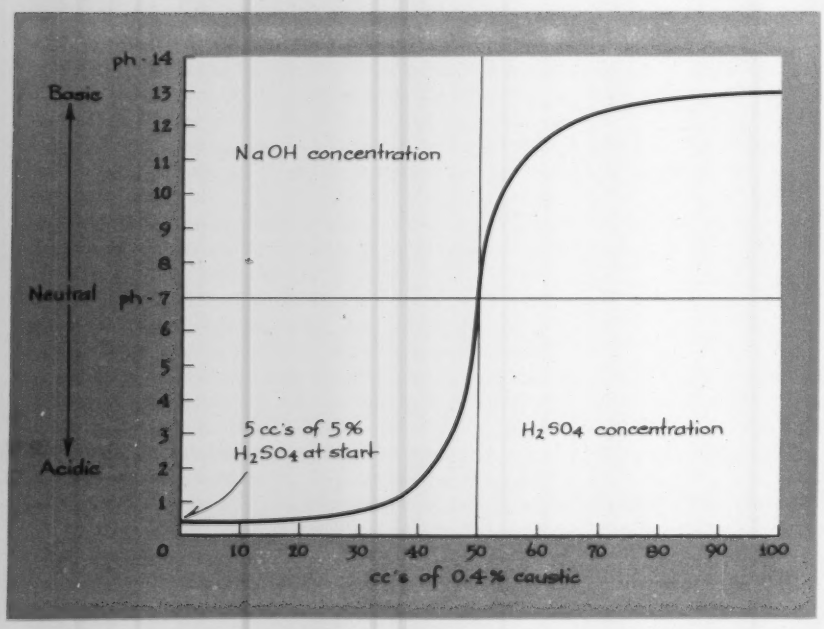
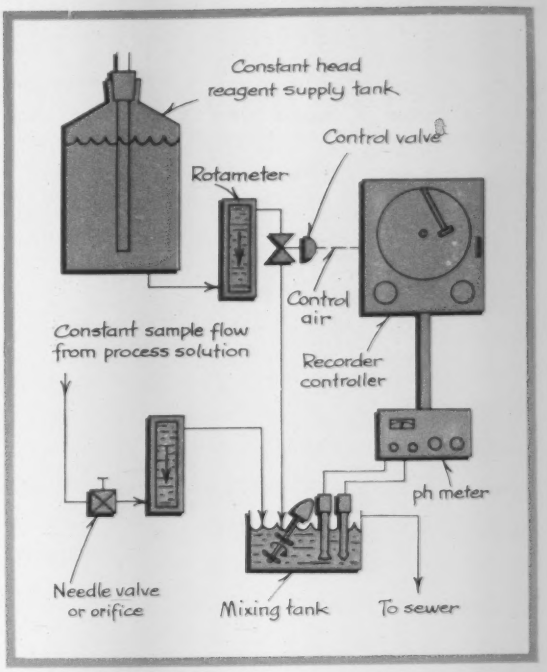



Fig. 4—Titration curve for a 5 per cent solution of sulfuric acid shows the effect on the pH factor of adding a 0.4 per cent caustic solution. The addition of the first 40 cc of caustic to the acid solution causes a change in pH of approximately 1 unit. However, as the next 10 cc of caustic is added, the pH factor changes over 5 units as the acid solution is neutralized.

Fig. 5—Diagram illustrates an indirect method of measuring pH factors when continuously controlling strong acids and bases. A constant sample flow of the process solution is directed to a mixing tank. Electrodes in the mixing tank measure the pH value, and, through a pH meter and pneumatic controller, continuously admit a measured amount of reagent to neutralize the sample flow. By reading the flow rates of the sample and the reagent, the strength of the process solution can be determined from a titration curve such as is shown in *Fig.* 4.




such as chemicals, plating, or petroleum must continuously detect changes in concentrations of strong acids and bases. This presents a problem for direct measurement since the pH scale is not linear with concentration, and a change of one unit of pH represents a tenfold change in the effective strength of the solution. In the region of pH 7 plus or minus 2 pH units (weak acids or bases), direct measurement is accurate, as any slight change in acid or caustic concentration exhibits a marked change in pH. However, above or below these limits the change of pH decreases rapidly as the strength of the solution increases. For example, as a solution of 5 per cent sulfuric acid is diluted and approaches a neutral solution, there is a change in pH of about 6.5 units. But as the 5 per cent solution of sulfuric acid increases in strength to a 10 per cent solution, there is a pH change of only 0.17 unit.

When a solution is in the area of minimum pH change where direct measurement renders questionable results, the acid or base can be measured and controlled by an indirect or continuous titration method. First, a titration curve, *Fig.* 4, is plotted for the solution under consideration. The titration curve plots the change in pH value as increments of standard neutralizing solution are added to a definite quantity of process solution. Then a small sample flow of process solution is directed from the main reservoir to a mixing tank in which the pH measuring electrodes are immersed, *Fig.* 5. The electrodes measure the pH value, and, through a pH meter and a recorder-controller, admit a measured amount of reagent until the sample solution is neutralized. Knowing the exact amount of reagent required to neutralize a measured amount of process solution, the strength of the process solution can be determined from the plotted titration curve.

By maintaining a constant sample flow from the process solution to the mixing tank, and by measuring the flow rate of the reagent into solution, a continuous system of measuring strong acids or bases is feasible. Since the resultant mixture will always be maintained in a neutral condition, the immersed electrodes will have a considerably longer life span that if they had been immersed in strong acid or alkaline solutions. Changes in the flow rate of the reagent will immediately indicate changes in the strength of the process solution, permitting fast corrective action by manual or automatic means.

## can we help?

It has been pointedly mentioned at various times that in engineering automated systems new as well as old techniques and devices may prove extremely useful. Practical results require the investigation of all available equipment that can contribute to the effective development of suitable automatic lines. Information on such equipment is presented in various departments of the magazine each month as useful data become available. To aid in obtaining detailed data for further evaluation a post card is included on page 19. Take advantage of this service. The Editors will be glad to help in this or any other way.

# AUTOMATIC GAGE CONTROL OF

**Based upon intensive investigation and computer studies of metal strip rolling, automatic gage control systems have been designed. Extensive operating experience has proved the efficiency of gage control for cold rolling mills. Initial experience with the newer gage control of hot rolling mills points to equally effective means of obtaining improved product.**

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ONE of the basic high-production techniques in American industry is concerned with the production of metal strip by rolling. As with many techniques, the history of progress in strip rolling has been one of "more, larger, and better." Expanded use of rolled metal products, ferrous and non-ferrous, has both paced and followed the ability of mills to consistently produce strip to exacting dimensions—a requirement leading to the development of automatic gage controls within the last few years.

Automatic gage control of strip rolling mills has progressed to the point where it is no longer a novelty. Properly designed and applied, gage controls have proved themselves in use by improving both quality and yield to such an extent as to be considered standard requirements for new mills and valuable additions to existing mills.

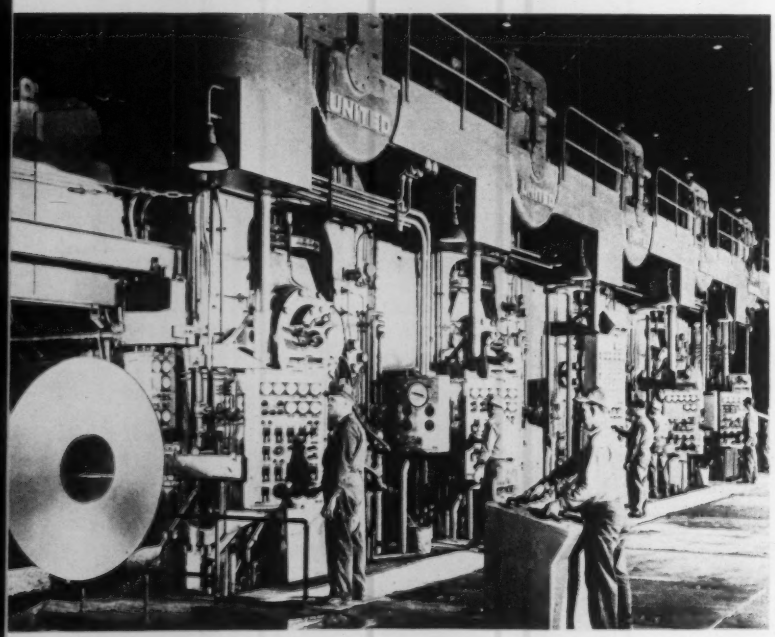
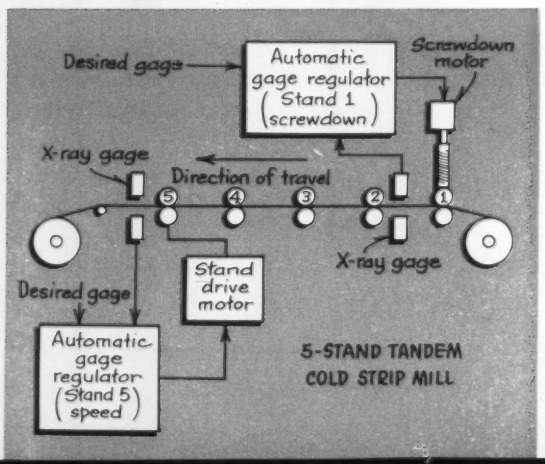


Fig. 1—Five-stand tinplate mill that is equipped with automatic gage control system is shown. Control of screwdown motion in first stand provides "coarse" control of metal thickness. Control of speed of fifth stand drive motor provides "vernier" control to obtain desired gage.



# METAL ROLLING

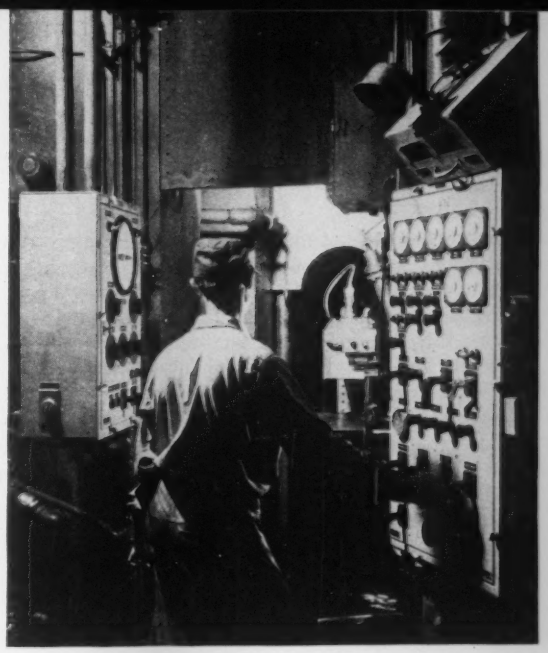


Fig. 2—Coarse control system for tinplate mill includes x-ray indicator, left; x-ray gage, center; and operator's control cabinet, right.

Strip is rolled in both hot and cold conditions. Hot rolling, in which strip is reduced to final thickness by heating and rolling at elevated temperatures, is the primary operation—and all strip passes through such an operation. Subsequent cold rolling of some of the strip enables mills to reach a gage not obtainable on hot mills and/or obtain a strip with different surface and mechanical properties.

Automatic gage control requirements for the two general types of rolling operations differ. The purpose of this article is to review these differences and the results of studies which the General Electric Co. has made in developing highly successful automatic control systems for rolling operations.

## ▸ Single Stand Mills

First to be considered is a single stand reversing 4-high cold mill. In such a mill, it has been found that it is desirable to use screw pressure to control thickness of the heavier gages, and to use back tension to control thickness of the lighter gages. The reason for this choice is that it is not practical to use either screws alone or tension alone throughout the whole range. At the heavy gages, tension alone cannot be used since the reel motors ordinarily have insufficient torque. In the light gages, screws alone cannot be used because of roll flattening (see box, "Fundamentals of Rolling and Measuring"). Studies show that roll flattening occurs on large 4-high mills, such as those 40 inch or wider, when rolling strip around the gage of tinplate or below. Thus, this indicates that the method of gage control employed on 4-high reversing cold mills depends upon the product rolled. For heavier gages only, screw pressure should be used, while for lighter gages only, tension would be preferable. Of course, for a combination mill it is quite practical to use screws and tension simultaneously and thereby cover a wide range of materials.

A number of automatic gage controls have been applied to single stand reversing cold mills. Most of these installations have employed radiation thickness gages on both sides of the mill with control being effected by means of screwdowns. All of these controls have been of the sampling type, which is required because of the transport time lag from the mill roll bite to the gage.

One automatic gage control installation in Canada uses the gagemeter method of indicating strip thickness deviation, as discussed in the box accompanying this article. The control varies both screws and back tension. Here, the gagemeter is a real advantage over radiation gage control since rolling speeds are usually fairly slow, and the transport time lag from the roll gap to a radiation gage becomes fairly long. On this Canadian mill, operators have achieved very good gage control down to thread speed. This mill also has radiation gages on each side of the mill to maintain the gagemeter in calibration.

## ▸ Tandem Cold Mills

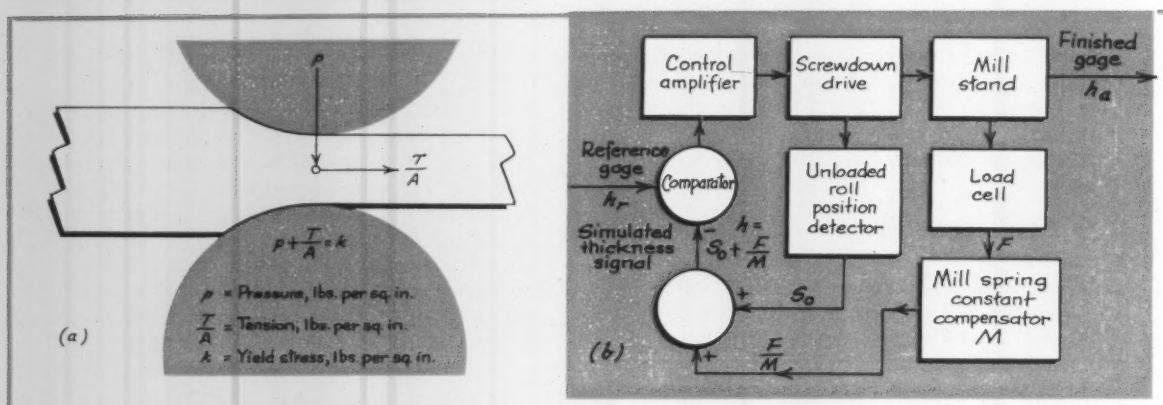
Next, consider automatic gage control on a 4 or 5-stand tandem cold reduction mill. A great deal of development work has been done in this important area, and the number of tandem mills with gage control is growing steadily. The major problem in selecting the control for a multistand cold mill is that of selecting the proper variables to use in the control of gage. As has been mentioned, it is possible to control gage in a roll gap by controlling either entering or exit tension or screwdown pressure. On a 5-stand mill, for example, there are six tensions and five screwdowns which could be varied. Of course it might be possible to control all variables, but for simplicity, a practical system must limit itself to a much smaller number.

Over the years the operating personnel of this type of mill have developed techniques of manually controlling thickness of the delivered product. It is almost universal practice to control gage as delivered from the fifth stand by varying the speed of the fifth stand drive motor. In addition, many operators keep the fifth stand in range by maintaining nearly constant thickness out of the first stand by means of screwdowns on the first stand. Thus, a promising solution to the problem of building a continuous automatic gage control system was to regulate the

thickness delivered from the first stand by controlling the screwdowns of the first stand, and to regulate the thickness delivered from the last stand by controlling the speed of the last stand.

With this in mind, a complete computer analysis was made and from it two completely separate regulators were designed for the automatic gage control of tandem mills, *Fig.* 1. A "coarse," sampling-type, regulator monitors an x-ray gage following the first stand and controls the screwdowns of that stand, *Fig.* 2. A "vernier," continuously acting, regulator monitors the final gage and controls the speed of the last stand motor. A number of systems of this type have been installed.

There are numerous alternate automatic gage controls which can be conceived for tandem cold mills. Of particular attractiveness from an economic viewpoint are those which measure and regulate thickness at one point only. With this in mind, an obvious alternate to the previous example is to use the coarse control of the first stand alone and eliminate the fifth stand vernier control entirely. Operation has also been observed on a mill operated with a fifth stand gage control only. Obviously, the cost for such systems will be roughly half of that for a coarse-vernier system. Experience indicates that the coarse control alone is usually sufficient to hold gage variation within present commercial tolerances and that the coarse-vernier system holds the de-




## FUNDAMENTALS OF ROLLING AND MEASURING

STRIP is made to flow plastically by squeezing it between work rolls, as shown in *Fig.* (*a*). If in addition, tension is applied to the strip as it enters or leaves the roll gap, the roll pressure required will decrease. This is explained by plastic flow theory which states that the vertical compressive stress plus the longitudinal tensile stress must equal the yield stress at every point in the roll gap.

The rolls and the mill housing act like a large spring, and tests show that the combination obeys Hooke's Law in the working range; that is, there is a linear relationship between the change in work roll force and change in roll opening. Therefore, when tension is applied at either the entry or exit side of the roll gap, the roll pressure decreases and the work rolls move closer together until a new point of equilibrium is reached, where compressive stress plus tensile stress once more equals the yield stress. The delivered thickness of the strip thus decreases. This suggests that outgoing thickness can be decreased by increasing incoming or outgoing tensions, or by increasing roll pressure.

One exception should be noted. As the ratio of roll diameter to strip thickness gets larger, the rolls begin to flatten to a rather large extent over their arc of contact with the strip. Finally a point is reached where an increase in roll force with constant incoming and outgoing tension produces a thicker strip (relative to what it has been producing) rather than a thinner one. What happens is that the flattened rolls cover a larger area of strip in the arc of contact than before and, although the total roll force has increased, the force per unit area actually decreases. When this condition is approached, effective control must be by tension. Thus, regardless of the type of mill considered, the gage controlling means must use one or both of the methods on one or more stands of the mill.

There are three basic means of gaging the thickness of the metal in a rolling mill. These are: Contact gages, noncontact gages, and the use of the mill stand itself as a gage. The contact gage utilizes small rolls above and below the strip. The separation of these rolls is measured mechanically and gives an electrical indication of thickness. In the second category are x-ray gages and radioactive source gages.

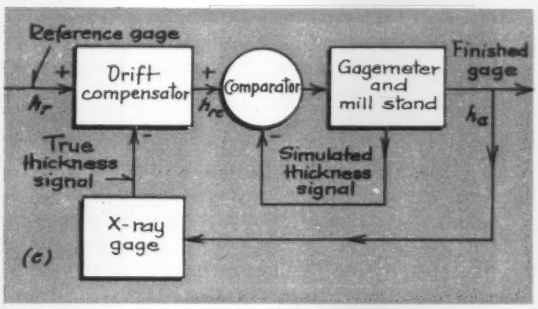
The third method of measuring thickness utilizes the fact that the mill stand and rolls act as a large spring. If one knows the separation between the rolls before metal enters the rolls and then measures the springing apart of the rolls and mill, an indication of strip thickness is obtained. This is not as difficult as it may sound. To accomplish this, the roll separating force is measured by means of load cells behind the backup roll chocks and divided by the spring constant of the mill (expressed in pounds

livered gage variation to one-half that obtainable with the coarse control alone. There is reason to believe, however, that today's premium strip will be tomorrow's standard.

There is also another lower cost approach applicable to tandem mills with adjustable voltage drive for each stand. In fact, this system has been added to two existing tandem mills. This system does not use a gage after the first stand or automatic screwdown control on that stand, and thereby saves that expense. The system observes the gage error leaving the last stand and controls the tension between all stands.

For example, when the finished thickness becomes heavy, the first and second stands are reduced in speed and the last two stands are increased in speed. The accuracy of gage control as observed on one mill operating with this system appeared to be about the same as obtained with the coarse or first stand gage control only. However, the operating range appeared to be less. Also, analyses indicate that such a system will be slower than the system shown in *Fig.* 1 since there is a long time delay before gage corrections made in the early stands reach the x-ray gage located after the last stand. When gage is corrected in a stand and measured immediately following that stand, only a very short time delay occurs before the new thickness reaches the gage. It is estimated that the speed of response of finish gage correction for the system shown in *Fig.* 1 can be about twice as fast as a system working through speeds of Stands 1, 2, 4, and 5 and taking its signal from a radiation gage following Stand 5.

So far as cold rolling of very thin metal is concerned, gage controls similar to *Fig.* 3 have been installed on a number of aluminum foil mills. This gage control utilizes the effect of speed on material thickness. It is well known that the thickness decreases as the speed increases. When rolling thin foil, this effect is very pronounced. Thus, the gage control detects the thickness error from an x-ray gage and, by means of a continuous control, modifies the speed of the mill stand to correct the gage. Results have been excellent with this type of control. Unwind tension is sometimes used in combination with speed during breakdown passes on heavy material.




required to separate the rolls one inch). This is then added to the unstressed roll separation to obtain the stressed roll separation, *Fig.* (*b*). This is done electrically.

The third method of measuring thickness gives an instantaneous indication of thickness change. As soon as the thickness changes, the rolls spring to indicate the change. This method of thickness measurement is known as the "gagemeter." When used in closed loop gage control, the gagemeter thus has an advantage over other means of gage measurement since no transport delay is experienced. However, the gagemeter has some shortcomings which must be fully appreciated before applying it. Changes in roll diameter are not recognized by the gagemeter and will thus cause errors. When the diameter changes at a slow rate, such as due to thermal expansion or wear, the effects can be removed by manual or automatic recalibration from, say, an x-ray gage, *Fig.* (c). On the other hand, back-up roll eccentricity represents a rapid diameter change and, therefore, presents a problem. If the eccentricity is small compared to the product accuracy desired, the eccentricity can be largely ignored. This is the case on most hot mills. However, when the eccentricity is large compared to the product accuracy, certain precautions must be taken. This is the case on most cold mills. Actually, back-up roll eccentricity can sometimes make the gagemeter gage control less accurate than a control operating from an x-ray gage alone.

## ▶ Hot Strip Mills

The subject of automatic gage control for hot strip mills is a complex one permitting only brief coverage. One of the reasons that it appears so complex is because of the lack of operating experience with automatic gage control for this type of mill. Today, only one such system is in operation, although several are now on order. Also, there are no hot strip mills equipped with digital data processing equipment. Without a background of operating experience and with the difficulties associated with manually logging and analyzing myriads of data, factors which may influence such a control must be analyzed with great care, and this in turn leads to the consideration of the most minute details.

Consider some of the factors which cause the thickness from a multistand hot strip mill to deviate in the first place. There appear to be three major factors: 1. Loss of tension at the front end and the tail end of the strip. 2. Variations in incoming temperature. 3. Variations in incoming thickness. Since the front end and tail end of the material are rolled without the aid of tension, the thickness of material leaving the last stand is heavy for approximately 100 feet or so at the head end and the tail end of the strip. The variations in temperature of the metal which enters a mill are due to water-cooled skids in the reheat furnace and to the general cooling off of the slab as it lies on the approach tables. This produces a temperature profile somewhat like that shown in *Fig.* 4.

Incoming thickness variations are usually due to

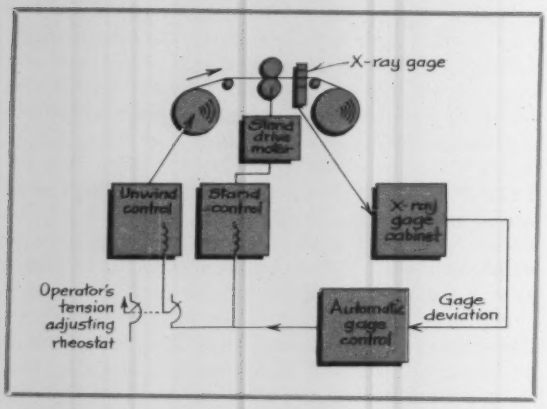



Fig. 3—Automatic gage control system for aluminum foil mill provides for continuous control of the mill stand speed. Unwind tension control is used in combination with speed control during breakdown passes on heavy material.

the effects of temperature variations in the preceding mills. In addition, if the rougher is a reversing mill, there can be differences in thickness from slab to slab due to slight inaccuracies in the setting of the screwdowns on the rougher. Card program control in the rougher should minimize variations due to this cause.

There is one factor which must be kept constantly in mind when considering means of controlling gage on a hot strip finishing mill. This is the fact that the tension between stands must be maintained within fairly close limits. If the tension becomes too low the material does not track very well and tends to wander up against the side guides. If the tension is too great, there is a tendency for the strip to neck down in width and for the tail end to have a significant increase in thickness. The curve in *Fig.* 5 was calculated, using a digital computer, for tensions of 4000 pounds per square inch between all stands. Tensions significantly above this level are generally considered to cause significant variations in width which of course are undesirable. Obviously, there is no way to increase the width of the material in the finishing mill once it has been necked below nominal.

This leads to the general conclusion that most of the gage controlling should be done by means of screwdowns while maintaining tension fairly constant and at a reasonably low value by some other means. Of course, it is likely that a slight variation in tension to achieve vernier control of gage could be tolerated.

The gagemeter can be used to obtain gage control through screwdown control (gagemeter-screw) or through interstand tension control (gagemeter-tension) or a combination thereof. The system for a 6-stand hot strip finishing mill which produces the most uniform thickness throughout the entire length of strip incorporates four gagmeter-screw systems (on Stands 2, 3, 4, and 5), *Fig.* 6. Such a system does not cause appreciable change in interstand tensions. Therefore, strip width is not affected. Cold (and therefore hard) spots in the slab are "ironed" out through the action of successive regulators. Tail end gage buildup due to temperature rundown and loss of tail end tension that occurs on a conventional mill are minimized. An x-ray gage is used after the last stand to monitor the system and to record final strip thickness. Stand speed regulators, though not essential, are recommended for ease of setup and operation.

There are less precise automatic gage regulating systems which will perform well for many applications—and at lower cost. For example, a good job can be done with gagemeter-screw systems on Stands

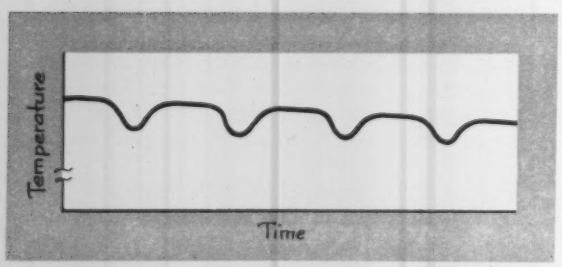



Fig. 4—One of the major factors causing changes in thickness of strip produced on a hot mill is temperature variation. Plot shows typical temperature pattern along length of slab entering a hot strip finishing mill.

Fig. 5—Graph indicates gage profile of tail end of strip processed in hot strip finishing mill. The curve was calculated, on a digital computer, for tensions of 4000 psi between all stands. The tail end will significantly increase in thickness at excessive tension settings because of lower roll pressures used with the higher tensions (the roll pressure determines gage with loss of tension). Excessive tension also causes strip to neck down in width.

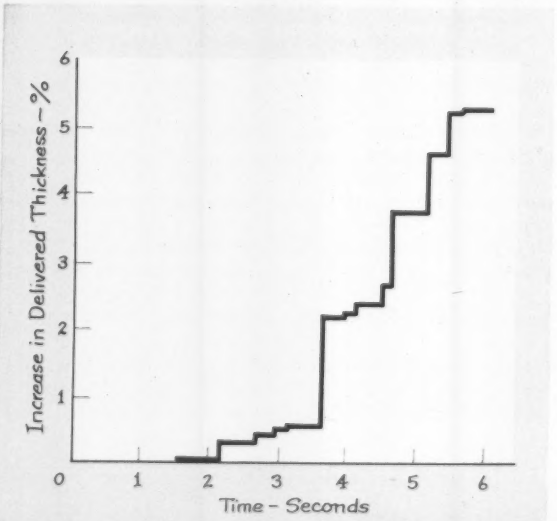
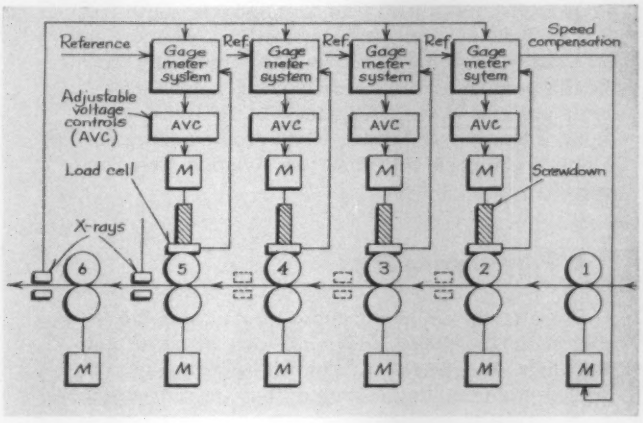
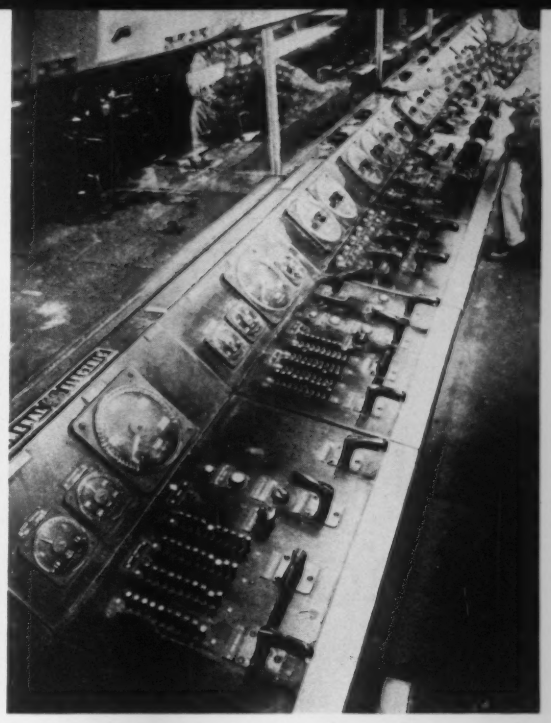


Fig. 6—Gagemeter control systems for six-stand hot strip finishing mill are applied to four of the stands. The control systems adjust the screwdown to maintain a uniform thickness throughout length of strip. X-ray gage after the last stand monitors strip thickness and records final strip gage. Photograph shows control pulpit for hot strip finishing mill.



2 and 3 along with a gagemeter-tension system on Stand 5. Large gage variations are reduced in the gagemeter-screw stands so that only small vernier changes need be made by varying tension using the Stand 5 gagemeter-tension system. These tension variations will not affect strip width beyond normal commercial tolerances. The combination gagemeter-screw and gagemeter-tension systems cannot control thickness at extreme ends to the degree that the all gagemeter-screw system does. Speed regulators are mandatory to provide the precise and rapid control of stand speed required by the tension control.

Stand 1 has not been chosen for gage control since the off gage does not begin to occur until the strip leaves that stand, thus it must be corrected in later stands.

Stand 6 has not been chosen for gage control since the roll force on this stand must be maintained nearly constant to obtain the proper shape out of the mill.

While only one hot strip mill automatic gage control with gagemeter-screw on Stand 2 and gagemeter-tension on Stand 5 is in operation at this date, its performance has so closely substantiated analysis, and it has been so successful that a number of systems are now in manufacture. More should be in operation within the coming year.

## Other Considerations

It is important to point out that gage control as described above is only one of the steps which might be taken to improve the operation of the hot strip finishing mill. For example, stand speed variations due to impact loading or to high and uncertain speed regulation in the stand motors has a detrimental effect on gage and tends to make the mill more difficult to set up for a schedule change. Thus, one of the first steps that might be taken to improve the operation of the mill would be to add speed regulators to each of the stands. These regulators will maintain the stand speeds at precisely the values set by the operator. In addition, the recalibration of speed required by the gage control should be accurate and have fast response. Operating experience with speed regulators on the Corniglianо 80-inch hot strip mill at Genoa, Italy, the Columbia-Geneva mill at Provo, Utah, and Jones & Laughlin's Cleveland Works mill has been extremely satisfactory. The number of cobbles has been reduced significantly with a corresponding increase in production. Gage variations have also been reduced.

Another addition that might be considered before gage control, or at least along with gage control, is the addition of programmed screwdowns. As a first step the screws could be programmed from decade pushbuttons. These would permit the operator to preselect the screwdown settings for the next slab while the present slab is still in the mill. Thus, when the present slab leaves the mill, the screws would quickly run to their new position. This would permit the operator more time to make the proper selection of screwdown position. Furthermore, screwdown position regulators would permit the gage control operating through the screwdowns to function more rapidly and more accurately.

As mentioned previously, gage control for hot strip mills is a new field, and there is much to be learned. We are just beginning to accumulate operating experience. However, much time has been spent analyzing this problem on digital and analog computers. Considerable analytical data is available and it serves as a firm foundation for field tests and serious discussions on the subject.

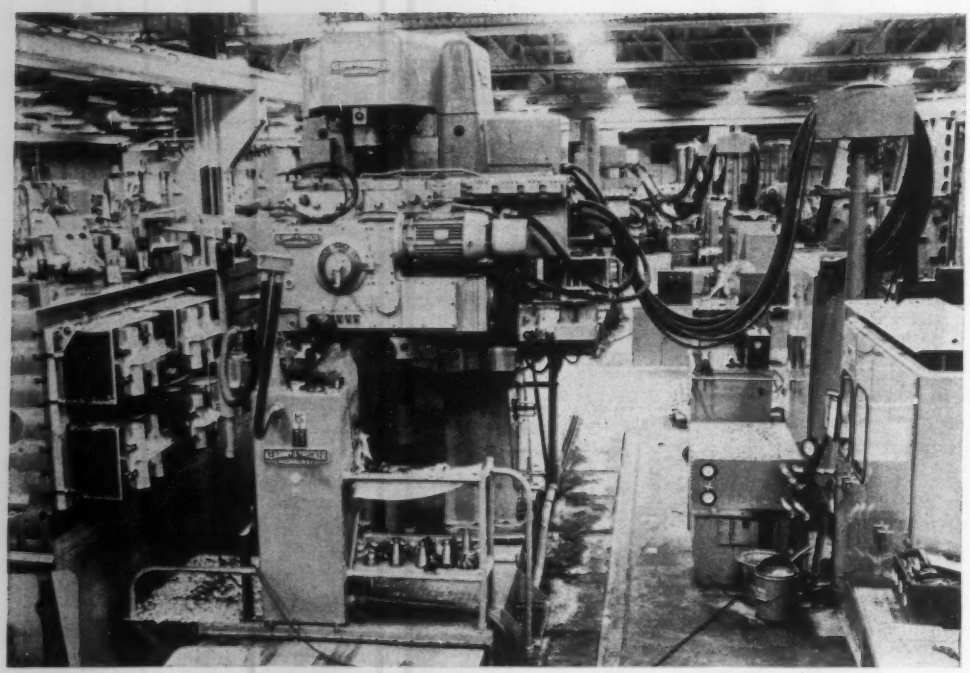
# AN EXPERIENCE REPORT ON TAPE CONTROLLED PROFILING

CONTINUOUS PATH numerical control of a machine tool is proving itself a cost and time saving technique over manual control methods in the production of several types of aluminum aircraft parts at Boeing Airplane Co. In these operations, a Kearney & Trecker Corp. profile milling machine is equipped with a Bendix Aviation Corp. numerical control system.

## Programming Steps

Preparation for manufacture of typical parts begins with tool design and fabrication based on part drawings. In general, tooling for numerically controlled profile milling is simpler than for conventional methods, since the need for templates or cams is eliminated. Fixtures may also be of simpler design when operation is to be numerically controlled.

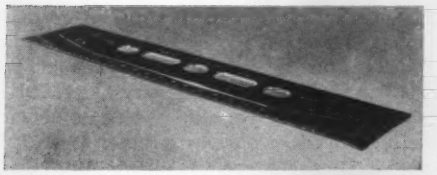
Production planning follows tool design and fabrication. This phase usually requires more manhours of effort for numerical control, since it is necessary in this case to organize the manufacturing data into a form suitable for input to a computer. The resulting manuscript must contain all pertinent infor-



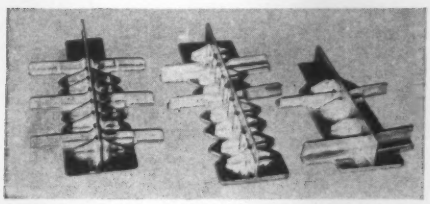
Profile milling machine in foreground is equipped with punched tape numerical controls for continuous path guidance of cutters. Machine is used in production of aluminum aircraft parts.

**Table 1—Preparation and Machining Time Comparisons for Various Parts**

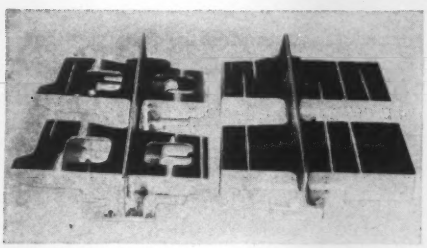
*(Conventional versus Numerical Control of Profile Milling Machine)*



| Reinforcing Doubler (aluminum plate) | Conventional | Numerical Control |
|---|---|---|
| Lead time | 5 days | 1 day |
| Machining time (first part) | 25 hours | 1.2 hours |
| Machining time per part (in production) | 6 hours | 0.5 hour |
| Hand finishing time per part | 2 hours | 0.17 hour |



| Vent Splice Fitting (aluminum forging) | Conventional | Numerical Control |
|---|---|---|
| Tool design | 300 manhours | 200 manhours |
| Tool fabrication | 2100 manhours | 1500 manhours |
| Production planning | 80 manhours | 300 manhours |
| Data processing | — | 10 manhours |
| Machine setup | 18 manhours | 10 manhours |
| Total preparation effort | 2498 manhours | 2020 manhours |
| Machining time per part (in production) | 18 hours | 8 hours |



| Fitting (aluminum forging) | Conventional | Numerical Control |
|---|---|---|
| Tool design | 390 manhours | 279 manhours |
| Tool fabrication | 3083 manhours | 2166 manhours |
| Production planning | 16 manhours | 35 manhours |
| Data processing | — | 8 manhours |
| Machine setup | 6 manhours | 3 manhours |
| Total preparation effort | 3495 manhours | 2491 manhours |
| Machining time per part (in production) | 11 hours | 7 hours |

mation—dimensional data defining part geometry, cutter sizes, feed rates, sequence of cuts, etc.—in proper order for processing.

In the next step for numerically controlled operation, IBM cards are prepared from the manuscript by a key punch. A card is prepared for each line of information on the manuscript, and contains exactly the same information as does the manuscript. The cards are then checked for accuracy by standard procedures. Verified cards are fed into an IBM 705 computer that interprets the data provided by the cards, calculates cutter center offset, interpolates curved sections to provide intermediate points defining a continuous cutter path, resolves feed rate into required speeds of the individual machine slides, and translates the decimal input information into a binary code form. The interpolation function performed by the computer establishes the required spacing of intermediate points on curved sections in accordance with the tolerances specified. This information is punched on control cards by the computer. The control cards are then fed into a card-to-tape converter which produces a punched plastic control tape containing the same information as the control cards.

In actual operation, the control tape is mounted on a photoelectric reader in the machine control unit. The control unit automatically picks up information from the tape and controls the milling machine to generate all of the motions required to machine the part.

## ▶ Economical Method

Numerical control of the profiling miller has effected cost and time savings over and above those that accrued from simplification of tooling, TABLE I. These additional advantages include reduced lead times, less inspection, and consistent machining accuracy. Use of verified punched cards and machine-punched tape containing machining instructions makes the operation less dependent upon operator skills. Production of defective parts through human error is also reduced. Tool life is prolonged, since optimum feeds and speeds can be programmed and maintained automatically. The permanent nature of the control tape enables subsequent scheduling of the same part without repeating the programming steps.

# CUTTING ACOUSTIC TILES TO SIZE

PRODUCTION of building products is one of the areas in which many operations are performed manually or with machines of very old standard design. But many progressive companies are applying automated systems which combine automatic handling and specialized machines to effect lower production costs. One example of this trend is found in a Johns-Manville plant making acoustical tile.

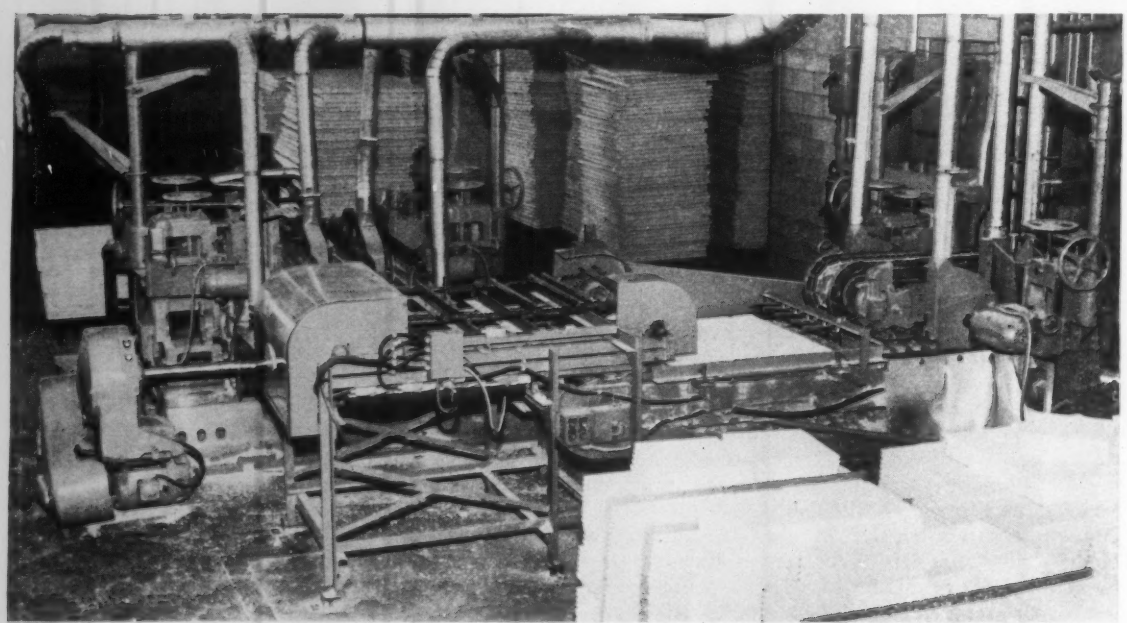
The basic materials from which the product is made include slag from steel mills and slags from chemical plants. Steps in manufacturing include preliminary melting of the slag at 2700 degrees, wet mixing, molding, loading on tray cars, and drying in gas-fired ovens. The rough-molded panels which result are about three feet square.

To trim and cut these large panels into nine squares measuring 12 inches on a side, Greenlee Bros. & Co. supplied two sawing machines linked by an automatic handling device. The large panels are manually fed into the first machine; tiles cut to size come out of the second machine.

Cutting is performed in the two machines by carbide saws. Both squareness and dimensions are determined by the operation. The tiles require no further operations for squaring or dimensioning after they leave the second machine.

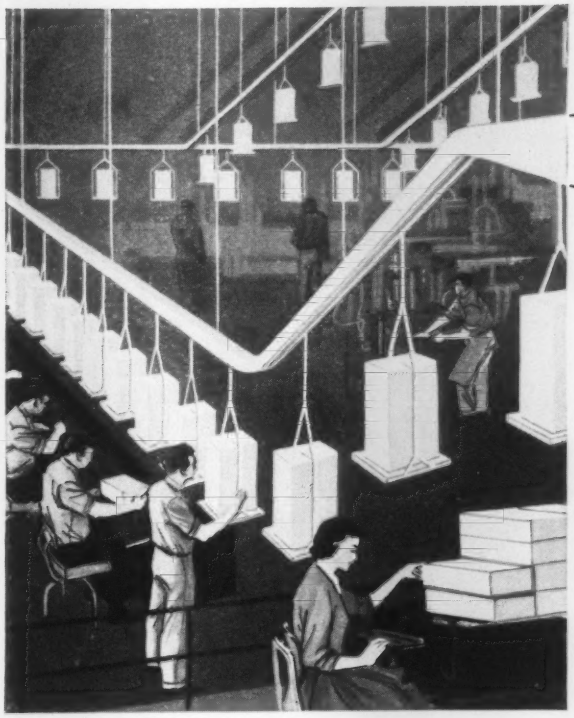
Material is carried through the machines on endless moving slat beds. Pusher bars on the slat beds provide positive stops to push material through the saws. Three overhead pressure beams on each machine are equipped with rubber-covered holddown blocks also arranged in endless chain fashion.

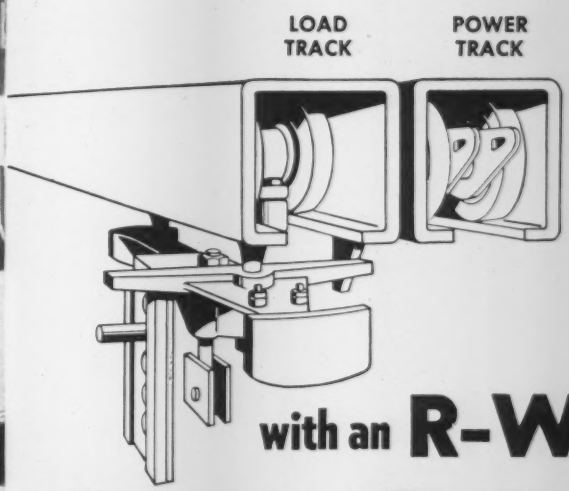
From the second machine, the tiles advance on gravity rollers toward edge machining, finishing, and packaging operations.



Large sheets of rough-molded acoustic material stacked in background are manually fed into far side of machine at left rear. Sides of sheets are trimmed and sheet is sawed into three long pieces. Transfer device in left center feeds the three pieces simultaneously into machine at right which trims ends of the three long pieces and saws each into three square tiles such as those stacked in right foreground.

# ENJOY COMPLETE AUTOMATION IN THE HANDLING OF MATERIALS



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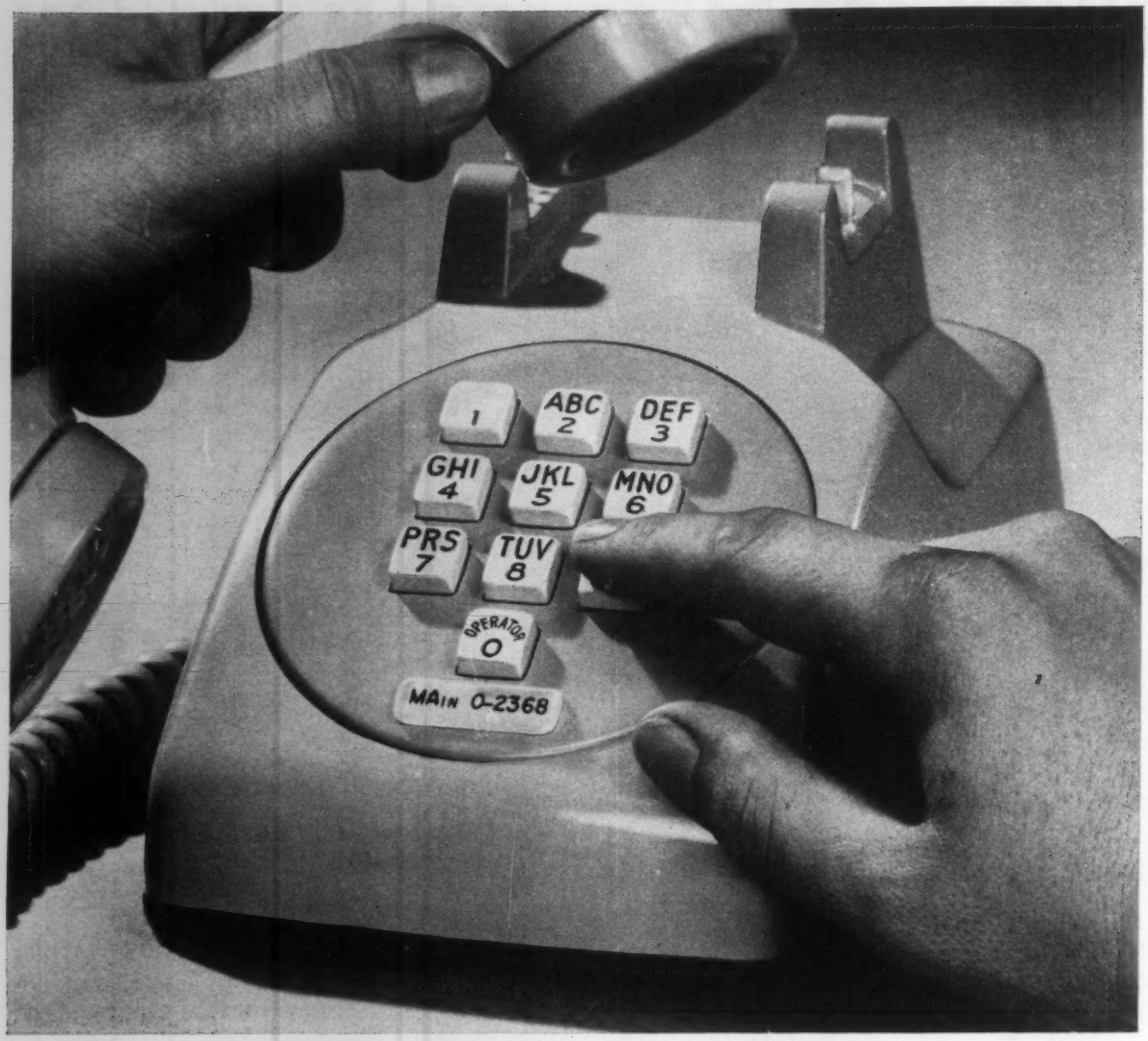
Circle 676 on Page 19




# NEW EXPERIMENT IN TELEPHONY

*It could speed up "dialing." Bell Laboratories people created it—and now it's being tested.*

The telephone you see above embodies an important new concept. It "dials" by means of push buttons—promises more convenient telephoning. Bell System engineers are currently testing it for public reaction. Bell Telephone Laboratories developed it.

The Laboratories' invention of the transistor makes it possible. For the transistor permits a new kind of calling signal generator, mounted within the instrument.

To insure ease of operation, psychologists studied human reactions to various finger pressures and sizes and arrangements of buttons. All factors affecting speed and accuracy were thoroughly evaluated. Electrical and mechanical engineers brought together the human and physical factors, created a practical piece of apparatus. Industrial designers worked out the functional shape.

The new instrument sends a calling signal quite different from that of your present telephone. This poses a problem. Complex automatic switching must be changed to handle the new signals as well as the old ones. Switching engineers must devise ways to make this change in *thousands* of central offices—economically.

Most of the challenges have been met. Final judgment on this new concept depends on the outcome of field tests. Meanwhile, Bell Laboratories continues in its task of originating and developing devices to improve your Bell System telephone service.

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WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

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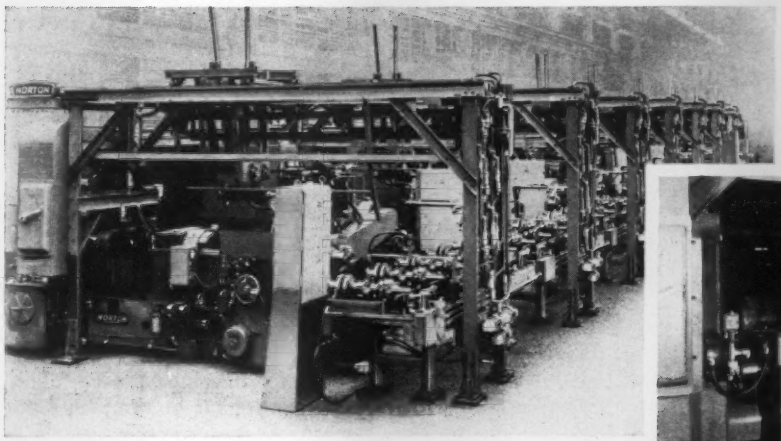
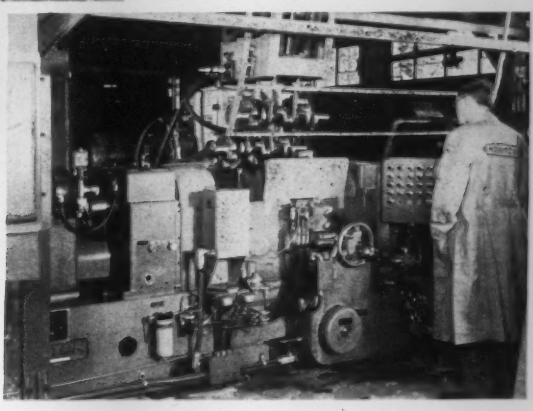
For detailed information and literature, use card Page 19.



Crankpin grinding system includes multiple grinding stations integrated by transfer devices that sequence crankshafts through stations. A separate crankpin is ground in each station. Output of system is 60 finished crankshafts per hour.



Close-up of grinding station shows transfer device automatically replacing ground crankshaft with unground crankshaft.

## Transfer Machine Finish Grinds Crankshafts

TRANSFER type crankpin grinding system can finish grind automotive crankshafts at the rate of 60 per hour. Operations such as loading, grinding, gaging, size control, wheel truing, and unloading are performed automatically. The setup, designed by **Norton Co.**, Worcester 6, Mass., includes seven grinding stations integrated by a transfer system. Each of the first six stations grinds a separate crankpin; the seventh station is reserved for substitute use or semiautomatic operation to increase system capacity.

A grinding cycle includes rapid infeed, fast feed rate for shoulder grinding, slower feed for roughing, a 4-second dwell, and a very slow infeed for final sizing and finishing of a pin. Size control is effected by in-process gaging. When final size is reached, air gages actuate controls which retract the wheel slide, ending the grinding cycle. Each station has independent controls for use in setting up and making adjustments. The stations can also be controlled automatically from a central control panel.

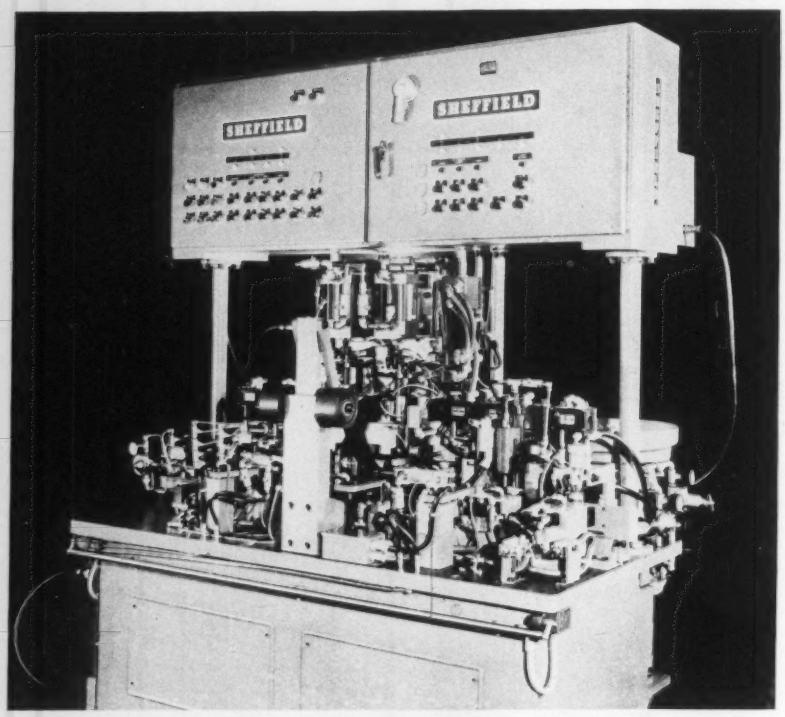
In operation, crankshafts are placed on a conveyor that runs the length of the system. When an unground crankshaft reaches the first grinding station, an overhead transfer carriage lifts it from the conveyor and transfers it laterally to the station. The carriage has two sets of hooks; one set removes a ground crankshaft from the grinding station, and the second set lowers the unground crankshaft into work position in the grinder. While the grinding operation is in progress, the overhead carriage returns the ground crankshaft to a position over the conveyor, picks up an unground crankshaft, deposits the ground crankshaft on the conveyor, and transfers the unground crankshaft to a waiting position over the grinding station ready to be lowered at the next cycle. Transfer carriages at each grinding station allow crankshafts to be programmed through all of the stations in sequence.

Post process gaging is performed each time a crankshaft returns to the conveyor. Three readings are taken on each pin so that taper as well as diameter can be checked. If a defective part is produced at a grinding station, that station is shut down automatically and the operator warned by means of signal lights. The rest of the machine can continue to operate, with parts automatically bypassing the station causing trouble. The seventh station may be brought into action to perform the function of the station that was shut down.

Wheel truing is accomplished

during the time that the wheel is not in contact with the work. Truing may be performed in each work cycle or after a predetermined number of cycles. Automatic truing devices true the face of the wheel and form the proper fillet radii on the corners.

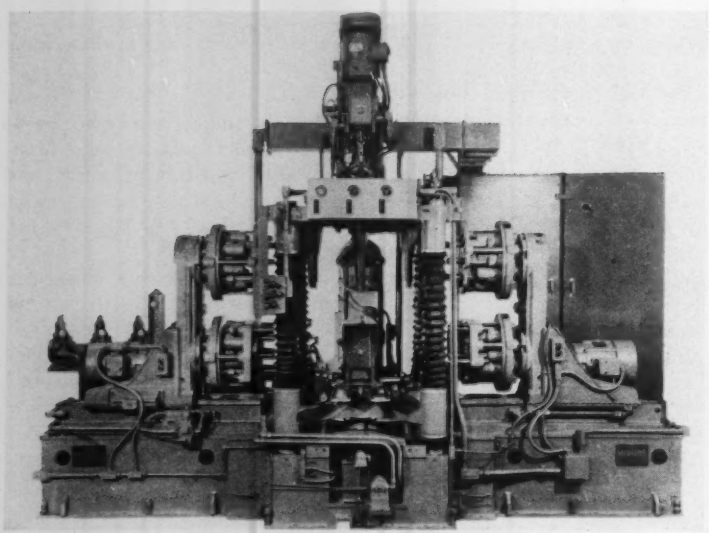
*Circle 401 on Page 19*




## Equipment Assembles Distributor Arms

Automatic assembly of five parts of an automobile distributor vacuum contact arm is performed on this machine at the rate of 900 units per hour. The parts assembled include: Arm, washer, two diaphragms, and retainer ring. Three different size arms can be accommodated. In operation, the arm is placed on a receiver that transfers it into the first assembly station. At this point a hopper fed washer is automatically placed on the arm. The assembly is transferred to the next station and the diaphragms, automatically blanked and pierced from two separate rolls of rubberized fabric, are added. Then the assembly is indexed to the next station where the retainer ring is added and staked. At the final operation, the staked spot is coated with a sealing compound. A preventive maintenance and timing system is built into the machine to allow quick connection of company's sequence time recorder through a standard receptable. **Sheffield Corp.**, Dayton 1, Ohio.

*Circle 402 on Page 19*



## Vertical Indexing, Drilling, and Tapping Machine

Four-way vertical indexing, drilling, and tapping machine makes 21 drilling and 21 tapping operations in one automatic cycle. A complete cycle requires only 30.5 seconds. It can accommodate ten different motor frame bracket sizes. To adjust the fixture to different frame sizes requires only that an operator interchange the fixture adapter plate, which compensates for the various centerline heights of the parts and adjusts the clamping fingers. A feature of the machine is the 20-inch square fixture mounting area which automatically raises and lowers to various machining stations. Unit consists of three 12-inch way type hydraulic drill units and an air-oil drill unit that is equipped with a turret head.

In operation, the three-way type units perform drilling operations in the lower position, then retract. The machine then indexes hydraulically in a vertical direction to the second position. The upper sections of the way type units drill and retract. Then the vertical air-oil unit drills, retracts, turret indexes, taps, retracts, and turret indexes to the original position. The machine then indexes back to the lower position

*Circle 677 on Page 19 for Fittings→*
*Circle 678 on Page 19 for Cylinders→*

Bronze cartridge gland with "LIPSEAL"® and "WIPERSEAL" can be easily replaced without dismantling cylinder.

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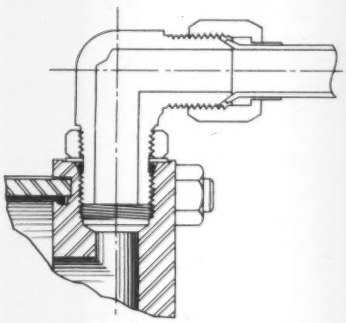
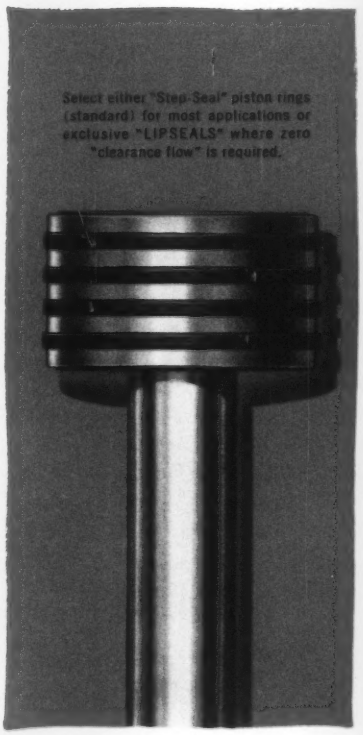


Specify straight thread O-ring bosses on your Hannifin high-pressure hydraulic cylinders for leak-proof connections at no extra charge. These port connections, together with Hannifin's drip-free rod seals, provide the answer to all your cylinder sealing problems.



Select either "Step-Seal" piston rings (standard) for most applications or exclusive "LIPSEALS" where zero "clearance flow" is required.

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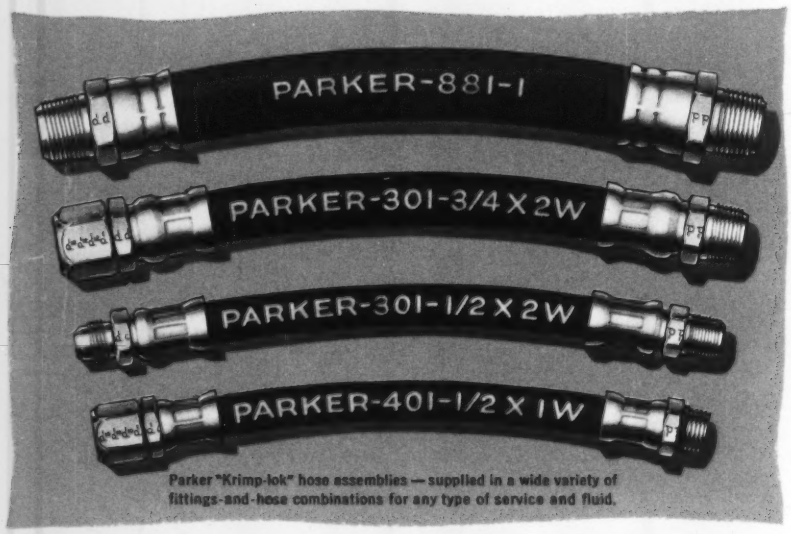
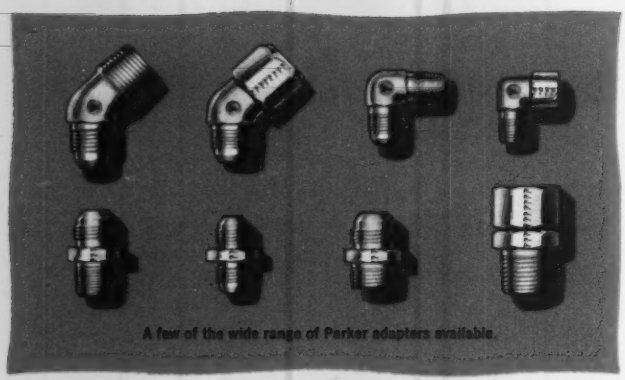



Parker "Krimp-lok" hose assemblies — supplied in a wide variety of fittings-and-hose combinations for any type of service and fluid.



A few of the wide range of Parker adapters available.

You may require permanent-end hose assemblies for your production AND re-usable fittings with coils of hose for quick, trouble-proof replacements in the field. With the addition of Parker's new "Krimp-lok" fittings, permanent-end assemblies are now available from Parker. They use the same Parker hoses that enjoy a wide acceptance when used with Parker *no-skive* "Hoze-lok" fittings in the replacement field.

A full range of Parker adapters is also available.

Ask your Parker Hose Distributor, listed in the Yellow Pages, for engineering advice and literature on "Hoze-lok" re-usable fittings, also Parker hose and adapters. Write us in Cleveland regarding your requirements for Parker "Krimp-lok" Hose Assemblies.

Parker "Hoze-lok" no-skive hose fittings and Parker hose, the ideal combination for short-run production and quick, reliable field replacement.

Parker

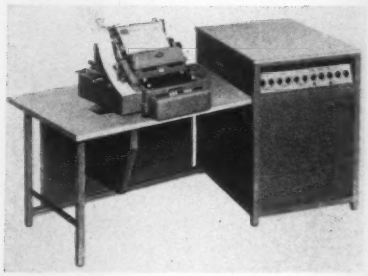
FITTINGS AND HOSE DIVISION

17325 Euclid Avenue

Cleveland 12, Ohio

and is unclamped for unloading. **Morris Machine Tool Co.**, 2011 Eastern Ave., Cincinnati 2, Ohio.

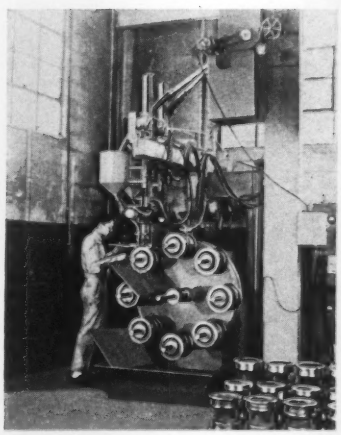
*Circle 403 on Page 19*



## Writing-Computing Unit

Automatic writing-computing machine can be operated by punched paper tape and/or tabulating cards. Simultaneously, it can produce a document at a rate of 100 wpm and produce a by-product punched tape. When connected to a key punch, it can produce tabulating cards. By-product tapes from Model CTS can be transmitted over telegraph or telephone facilities. Device, designated Computyper, can be used with a variety of auxiliary input and output units such as tape and card readers, and adding machines. **Friden Inc.**, San Leandro, Calif.

*Circle 404 on Page 19*

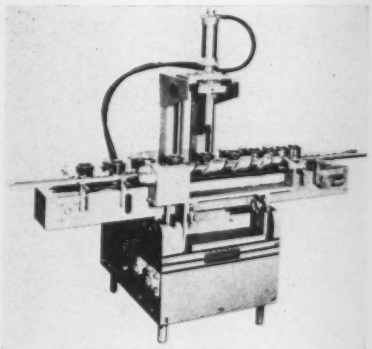


## Flux Circulating System

Eight spindle, dual head automatic tractor roller rebuilder is designated Model MS-8. Operation of the flux circulating system is automatic except for an operator emptying a bag of flux onto the vibrating screen. In operation, during the welding process, both fused slag and unfused flux fall from the weldment onto the vibrating screen of the circulating unit. The fused slag is automatically separated from the unfused flux and put aside. A mechanical elevator picks up the flux and lifts it to the hoppers, thereby maintaining a constant supply of flux at all times.

Equipment is designed so that both sides of the roller shells are built up simultaneously. Continuous welding is accomplished as the indexing from one roller to the next requires only a few seconds. By the time the first welded roller reaches the 8th index position, it is sufficiently cooled to take the second welding pass. **Sight Feed Generator Co.**, West Alexandria, Ohio.

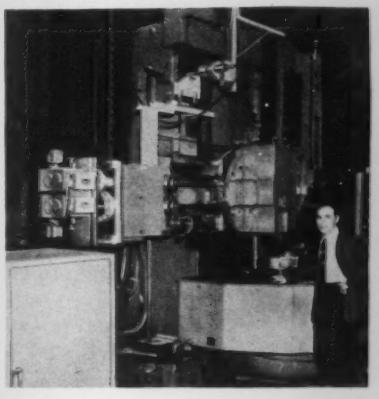
*Circle 405 on Page 19*



## Code Embosser

Equipment is suitable for code-embossing open-mouth cans ranging from ½ pint to 1 gallon capacity. This function takes place just ahead of the filling operation. Coding speeds are from 15 to 35 containers per minute. The code is automatically embossed on the container each time a timing screw on the machine feeds a can into coding position and holds it. The operation is accomplished by a fixed female die in the base of the machine and a moving upper male die that is fed downward by an air cylinder. Coding dies accommodate two rows of six letters or digits each. Initials and special code insignia are also available. **Arthur Colton Co.**, 3400 E. Lafayette, Detroit 7, Mich.

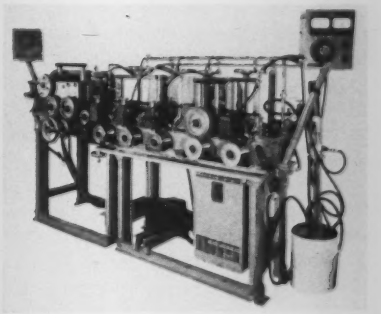
*Circle 406 on Page 19*



## Tracer Attachment

Electrohydraulic tracer control attachment converts vertical turret lathes for contour turning. Hemispherical or irregularly shaped surfaces can be automatically contoured both inside and out. Servo valves are mounted directly to piston motors to provide a tight position loop. This, complemented with tachometer feedback directly from the hydraulic motor shaft permits tolerances of ±0.005 at 25 ipm and ±0.0005 at speeds to 5 ipm. The lathe to which the attachment is connected may be operated conventionally when desired. **Tracer Control Co.**, 595 E. Ten Mile Rd., Hazel Park, Mich.

*Circle 407 on Page 19*



## Tube Cleaner/Marker

Unit accepts tubing which is coated with residual drawing compound and greasy materials, cleans it, and marks it with a combination offset-printing and indented-marking process. Machine is adjustable for bar and tube sizes from ¼ to 6 inches. Processing speed is adjustable from 125 to 1000 fpm. In operation, material to be marked

←*Circle 677 on Page 19 for Fittings*
←*Circle 678 on Page 19 for Cylinders*

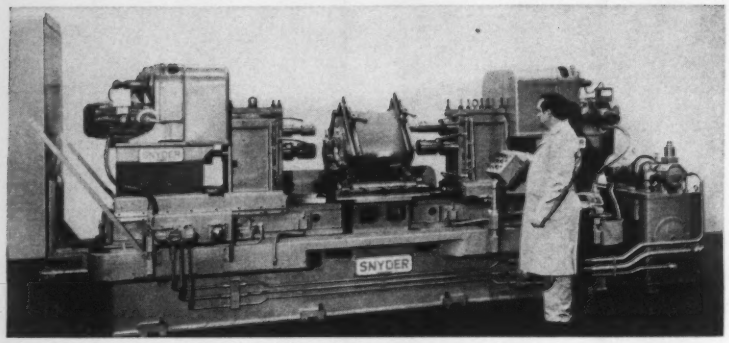
is advanced and guided by power-driven rolls. Spray nozzles apply solvent to the tube surface and adjustable squeegees remove all compound, loose materials, etc., which might affect the quality of marking. Offset printing is applied to the cleaned top surface of the work, and indented marking is made on the bottom. **Jas. H. Matthews & Co.**, 3962 Forbes Ave., Pittsburgh 13, Pa.

*Circle 408 on Page 19*

## Process Analyzer

Design of the instrument is based on the detection of refractive index differences between a process stream and a desired sample. Suitable applications include: Measuring and controlling of impurities in process streams; control of stream blending; concentration measurements; and identification of compounds from fractionators. The null type analyzer has a recorder, based on a repeater principle, that operates without batteries and standard cell. Various sensitivities combined with a special range extension feature allow suppression up to ten times the standard range without initial zero shift or change of reference solution. For special applications, the analyzer can be furnished with a mass or volume collecting system which replaces the synchronous chart drive on the recorder. This permits plotting of refractive index changes relative to the mass of the liquid sample passed, and presents this quantity on the *Y* axis of the X-Y recorder. **Phoenix Precision Instrument Co.**, 3803-05 N. 5th St., Philadelphia 40, Pa.

*Circle 409 on Page 19*

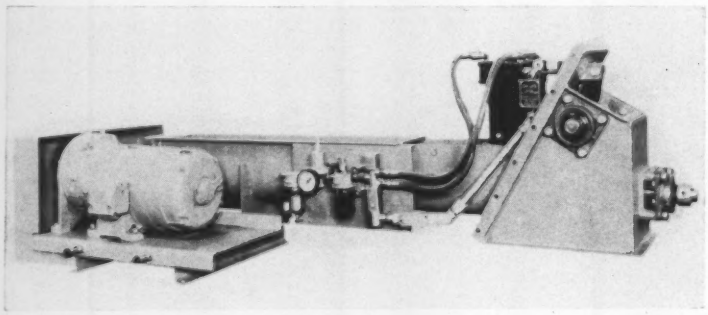



## Double-End Precision Borer

Unit can bore four holes in sixteen different transmission cases. The double-end precision borer can accommodate variations in hole size, depth, center distance location, overall length, and material. Cases can be precision-bored at rates of from 22 to 55 pieces per hour, depending on the part length. Boring machine consists of two way-type machining units mounted on a steel base; each unit has one flat and one V-way and a 19-inch maximum travel. Each unit also has a housing which contains two spindles and another base that supports individual 3 hp motor drives for each spindle. Between the two machining units, a T-slot table is mounted, which supports the work fixture. Under the fixture area in the base of the machine is a built-in chute which directs chips and coolant into a coolant tank at the rear of the machine.

Variations in part length and hole depth are handled by adjusting the axial position of the T-slot table and travel of the way units. Interchangeable boring bars accommodate hole diameter differences of up to 1¾ inches. Center distance variations of up to 1½ inches are taken care of by raising and lowering the upper boring spindle on each head through a sliding detail and spacer arrangement in the spindle housing. Spindle speed changes are provided through the use of a variable speed drive for each of the spindles. These drives supply the necessary 300 sfpm speed for cast iron and 1200 sfpm speed for aluminum. Interchangeable fixture details take care of part clamping variables. **Snyder Corp.**, 3400 E. Lafayette, Detroit 7, Mich.

*Circle 410 on Page 19*



## Automatic Proportioning System

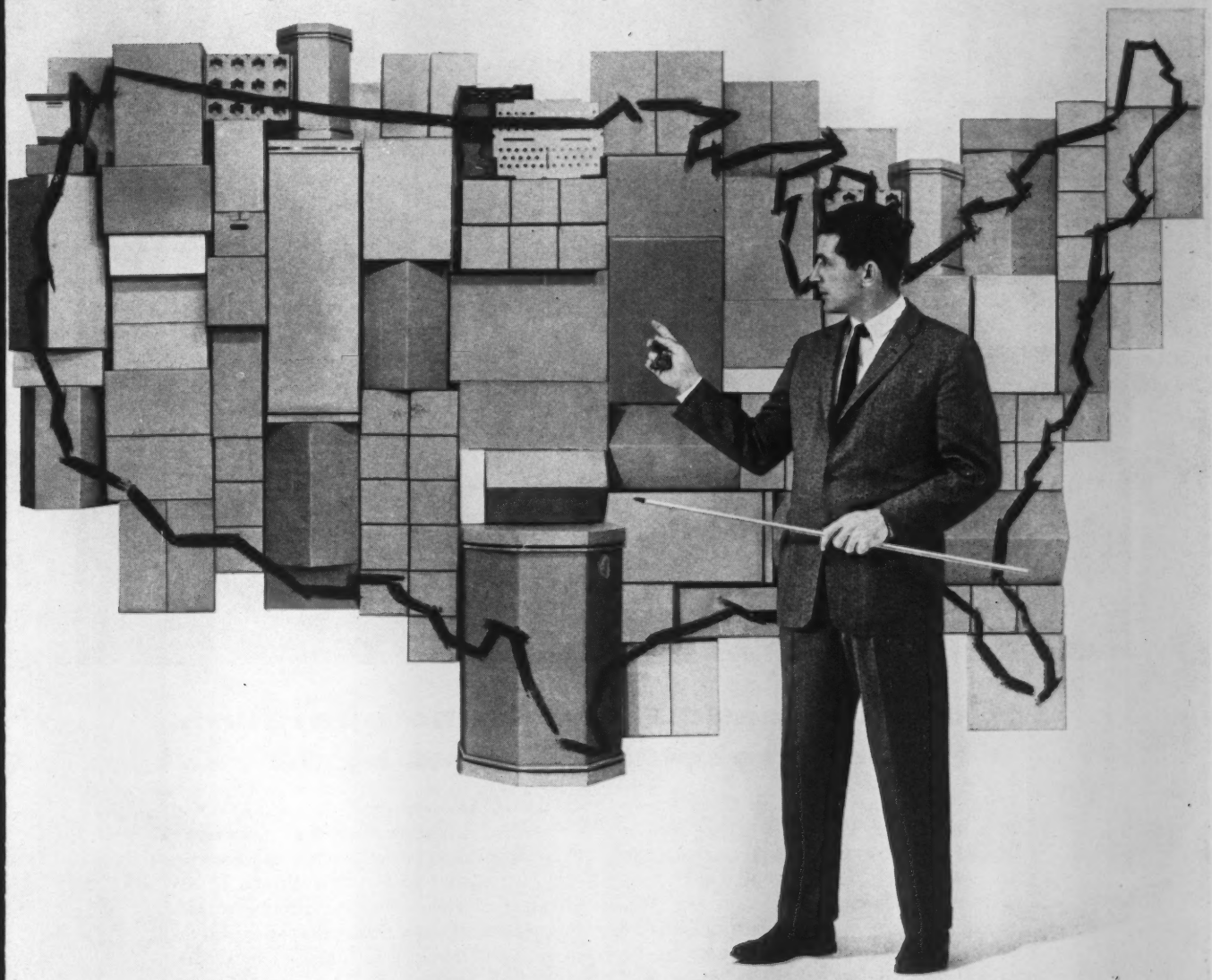
Designed for the proportioning of various types of clay in connection with oil refining processes, automatic system is also adaptable to other materials with similar characteristics. It can automatically weigh in a fixed sequence every five minutes, up to 3000 lb of 13 different materials. Equipment in the system includes a scale, a panel, and screw-type feeder assemblies (shown). The dial scale (3000 x 3 lb) is

*Circle 679 on Page 19→*

# GAYLORD GIVES LOCAL SERVICE
## ALL OVER THE PACKAGING MAP

At every important packaging crossroads, coast to coast,
there's a Gaylord Container plant or office to serve you.
Your inquiry brings a quick reply — with no detours
through channels or over mountains of red tape.

Avoid the byroads. Take the high road to full packaging flexibility.
Go Gaylord. Call your friendly nearby G-Man today.



**GAYLORD**
CONTAINER CORPORATION

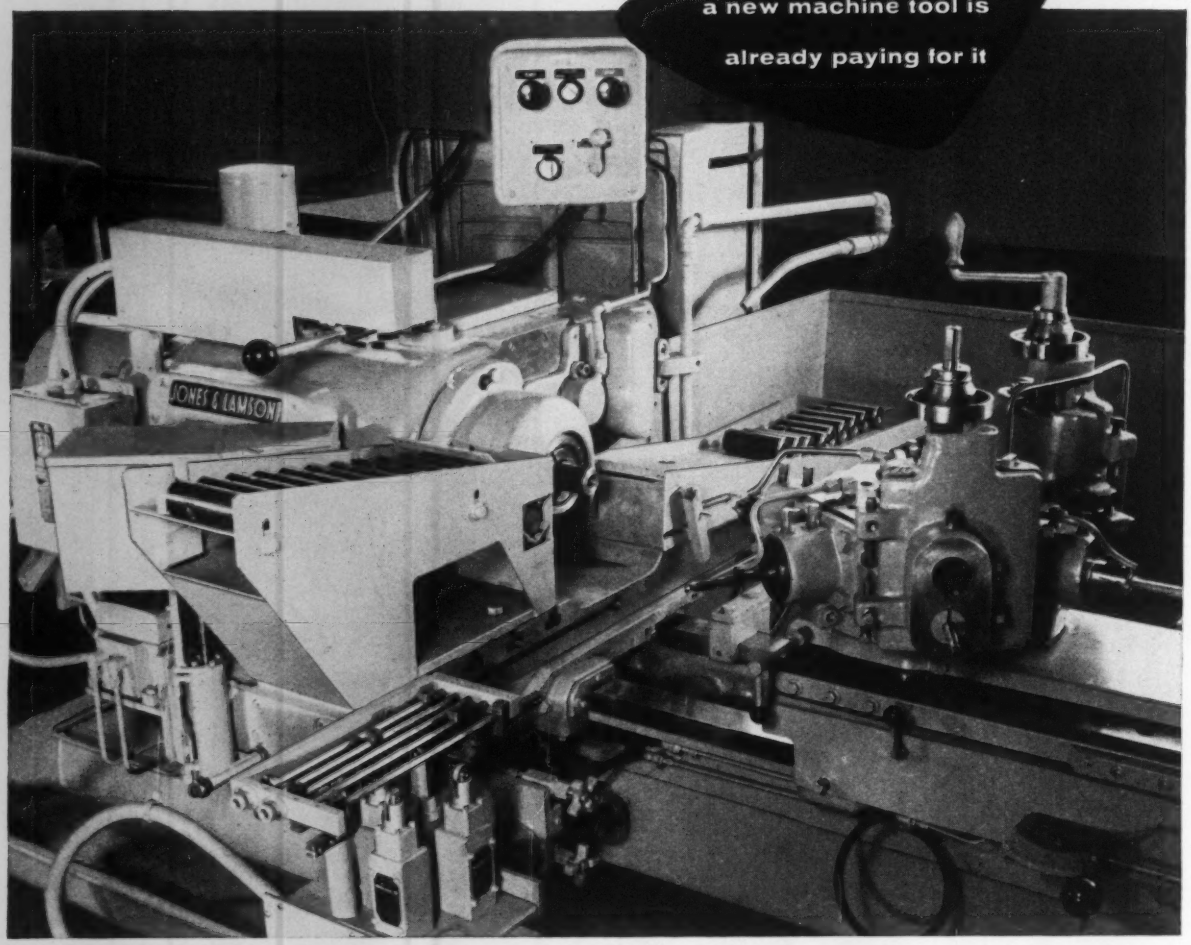
Gaylord Boxes

HEADQUARTERS, ST. LOUIS
PLANTS COAST TO COAST

DIVISION OF **Crown Zellerbach Corporation**

# JONES & LAMSON "AUTOMATION"

the man who needs a new machine tool is already paying for it




## Fully Automatic Turret Lathe operation reduces machining costs by 32%

This J & L Automatic Ram Type Turret Lathe with Lynn Hydraulic drive provides completely automatic operation from start to stop. A magazine feed for automatic work handling has been mounted on the cross slide. However, on applications where cross slide tooling is necessary, handling devices can be arranged that will free either the front or rear of the cross slide for tooling.

Fourteen similar parts of varying dimensions are produced on this same machine. The tooling used is basically the same as that used in the former, hand-operated method. However, on machining time alone, costs are reduced by 32%. Operator attention for this set-up is only one-third of that previously required. In addition, studies show that one operator can run two or more of these automatics with less fatigue than is involved in running one manual machine. Needless to say, J & L's long-standing reputation for turret lathe accuracy is retained throughout. Write for catalog 5808. Jones & Lamson Machine Company, 536 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

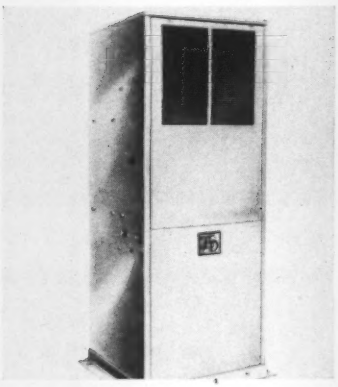


Circle 680 on Page 19

equipped for fixed sequence feeding of the materials. The feeders feature air-operated flush governors which control finely ground clays that tend to flush when withdrawn from storage bins.

The system can be used for either wet or dry processing. In operation, materials are discharged from a 40 cu ft weigh hopper through a bifurcated spout into process mixers. To decrease the dust from the discharge of the material, water enters the mixers just before the scale dumps the dry materials. For the dry process—before entering the mixers, the material is diverted from the scale onto a portable belt conveyor to another process. A slide plate in one of the pants-legs of the bifurcated spout is used for this operation. **Richardson Scale Co.**, Clifton, N. J.

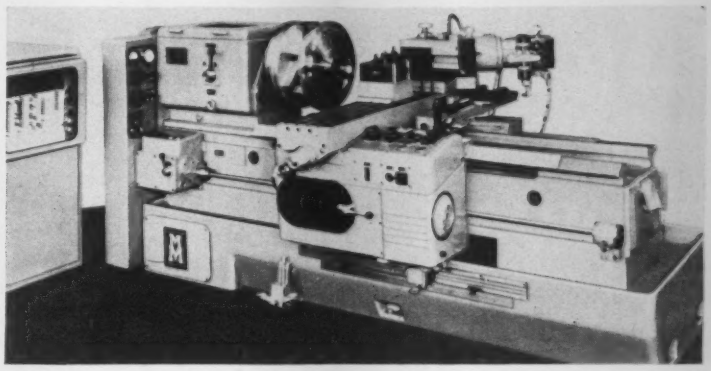
*Circle 411 on Page 19*



## Compressed Air Dryer

Self-contained, plug-in unit can deliver a continuous supply of dry compressed air at moisture levels ranging from −50F dewpoint to −60F dewpoint measured at atmospheric pressures. Condensed water is automatically and continuously ejected from the unit in accordance with the drying load. Model H25AP (shown) is designed for operation at compressed air inlet temperatures up to 100F to deliver air at levels above freezing. Refrigeration is handled by a ¼ hp air cooled condensing unit. Other models are available for low moisture level drying or for use as precoolers. **Technical Designs Inc.**, 119 Northfield Rd., Bedford, Ohio.

*Circle 412 on Page 19*

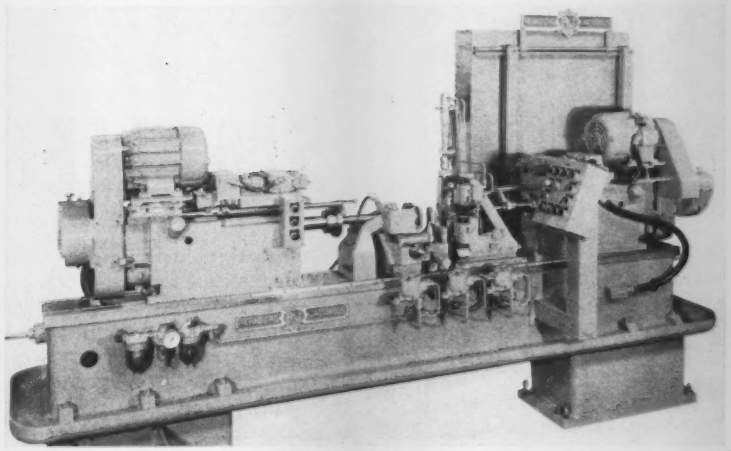


## Production Lathe

Equipment provides preset, automatic control of spindle speeds, feeds, feed directions, and rapid traverse as well as all tool movements on saddle, cross-slide, copy attachments, drilling units, and turret head. Key components in the system are a plug panel for accepting and issuing orders, a prepared punch-card to indicate correct placement of plugs in panel sockets, and interchangeable trip dogs set in cam plates according to desired dimensions. Control orders from the panel are determined by the location of the plugs. Impulses transmitted from the plugged panel socket lines actuate relays which carry out orders.

This system, designated Eltropilot, can store 60 commands and control 20 operations, with an infinite combination of 20 commands for any operation. Set-up requires only that the punch chart and trip dog positions are changed for each new component. The working cycle can be interrupted at any time and the tools will automatically return to their starting position. The system can control all machines which have electric motors, electromagnetic clutches, and hydromagnetic valves. It can also be used with textile, packaging, paper producing, and printing machines. **Cosa Corp.**, 405 Lexington Ave., New York 17, N. Y.

*Circle 413 on Page 19*



## Centering and Facing Machine

Machine is designed to center and spotface valve plugs ranging in size from 6 to 26 inches in length and from 2 to 6 inches in diameter. The machine is equipped with two hydraulic quill units with an 8-inch stroke. Extra equipment on the units include gear boxes, with

# General Electric Announces Newest In The Complete Line Of Adjustable-Speed Drives

**PARMATIC SPEED VARIATOR...newest in General Electric's complete line of packaged adjustable-speed drives . . . provides greater machine flexibility, better quality control, higher output and efficiency.**

## STATIC POWER

**for less maintenance, less downtime, added profit.** New excitation and power conversion systems have no rotating parts. Sealed silicon rectifiers and saturable reactors need no warm-up, virtually eliminate power unit maintenance.

## 25% SMALLER

**for easier installation.** Reliable, long-life G-E components are factory assembled in compact, space-saving power unit, wired and tested before installation to assure accurate control, reduced installation time and expense.

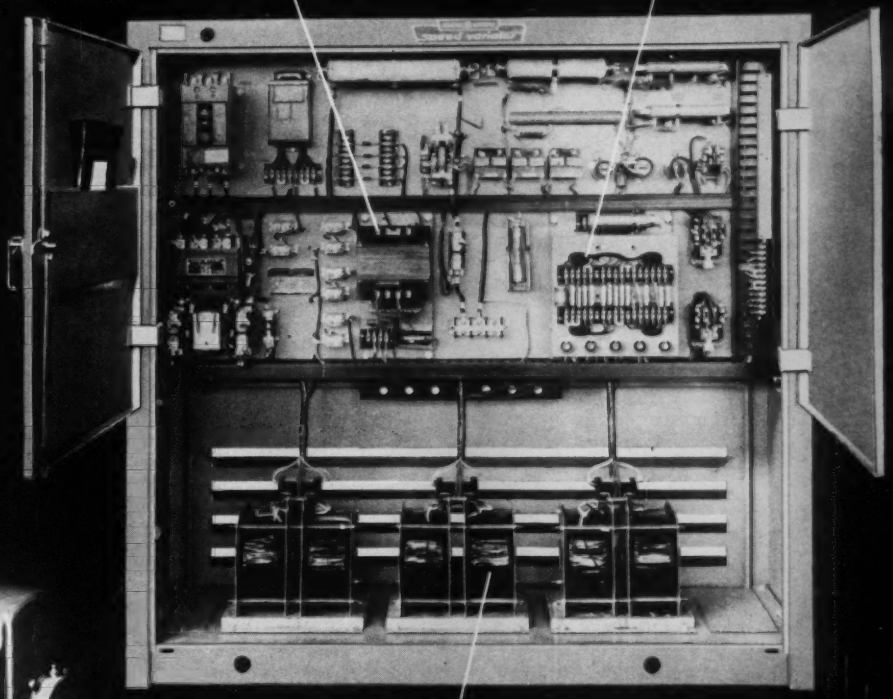
## 50% LIGHTER

**for lower shipping and handling costs.** New Speed Variator meets industry's demand for lighter, more powerful drives—packs more power, weighs 50% less than other drives of comparable rating, 2000 lbs less in 100-hp ratings.

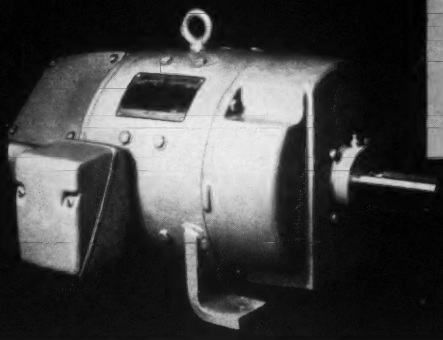
STATIC EXCITER with silicon rectifiers for motor field excitation and control power.

AMPLISTAT REGULATOR with adjustable acceleration and deceleration.

OPERATOR'S CONTROL STATION



KINAMATIC® D-C DRIVE MOTOR



SATURABLE REACTORS are virtually impervious to moisture and dirt, require no maintenance.

# FIELD PROVEN

**by two years' impressive on-the-job performance in several hundred installations in 15 industries.** Experience indicates high operating efficiency, lower cost installation and maintenance for a greater return on your investment.

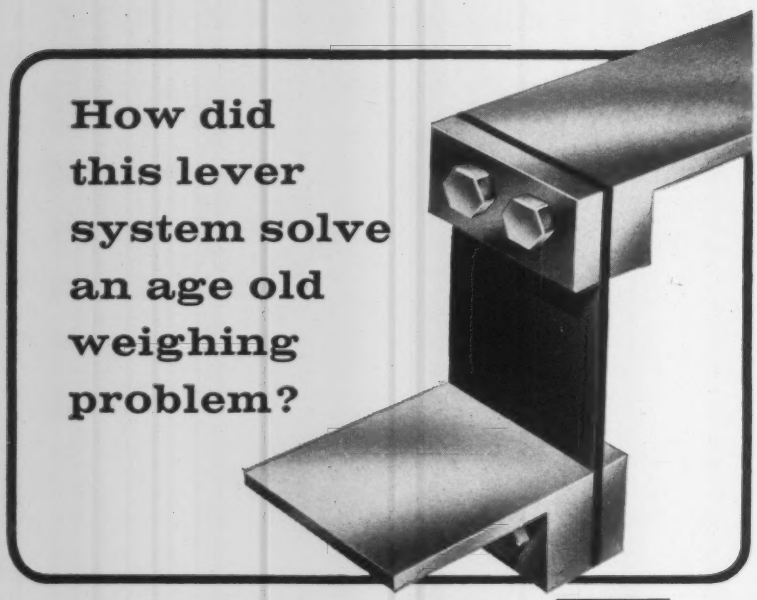
- **GOOD SPEED REGULATION:** 5% with 100% load variation. Closer regulation available with modification.
- **WIDE SPEED RANGE:** Standard Parmatic Speed Variator provides 8 to 1 range or wider if required.
- **RESISTS CONTAMINATION:** Saturable reactors and hermetically sealed rectifiers resist dirt and moisture.
- **QUIET AND VIBRATIONLESS:** New power unit design eliminates noise and vibration—expands drive versatility.

**Limitations:** G-E Kinamatic Speed Variator with motor-generator set is recommended for applications requiring power absorption for stopping or overhauling loads. *For more information*, call your General Electric Sales Engineer, or write for GEA-7012, Section 821-1, General Electric Company, Direct Current Motor and Generator Department, 3001 East Lake Road, Erie, Pennsylvania.

GENERAL ELECTRIC

Circle 681 on Page 19

**How did this lever system solve an age old weighing problem?**



PROBLEM

SOLUTION

Early man was aware of the progressive inaccuracies of his pivot balance scales . . . but none knew how to remedy the situation.

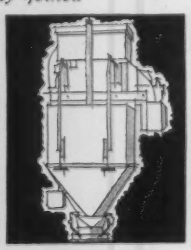
The problem was solved in 1956 when the United States issued a patent for a "Thayer Flexure Plate" Leverage System. A team of engineers and businessmen aware of industrys tremendous cumulative loss of materials in weighing operations, had devised a revolutionary new scale.

Knife-edge pivots that progressively wear and change were replaced by Thayer Flexure Plates that move only .001", yet accurately reflect the minutest changes in weight. This *firmly joined* lever withstands shocks and vibrations indefinitely. Dirt and dust are no longer a problem. Thayer guarantees this leverage system accurate for the life of the scale.

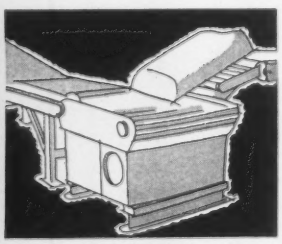
**How Can It Save You Money Year After Year?**

Working in conjunction with straight electrical controls, it forms the most reliable, low maintenance system ever devised to control processing or materials handling *by weight*. Literature on its application to filling, batching and checkweighing operations is available on request.

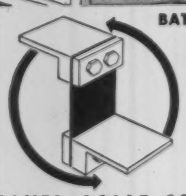
BATCHING



FILLING



CHECKWEIGHING



**THAYER SCALE**

**AUTOWEIGHTION SYSTEMS FOR FILLING, BATCHING AND CHECKWEIGHING**

**THAYER SCALE CORP. THAYER PARK PEMBROKE, MASS.**

Circle 682 on Page 19


pick-off gears mounted at the rear to provide a range of spindle speeds.

In operation, the valve plugs are loaded by an operator into the fixture and the part piece is located endwise from a locator. A rotating mandrel locates the cored slot centrally. Air motors operate a set of Vee clamps holding the part on the stem end, and a set of flat jaws clamping the valve plug on the tapered end. The endwise stop and mandrel are the only fixture parts requiring changing when the machine is set up from one size to another. **Rehnberg-Jacobson Mfg. Co.**, 2135 Kishwaukee St., Rockford, Ill.

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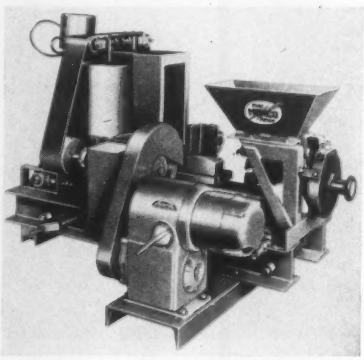

## Magnetic Separator

Belt separator features four wedge shaped edges on each pole and individual pole control. Each pole is equipped with a complete adjustable magnetic circuit for closer control. A hand crank adjusts the size of the gap between poles to conform to the product passing through the machine. When the control is set, future adjustments are made by rheostats mounted on the panel board. The placement of all windings above the main belt eliminates conflict in magnetic pull between upper and lower pole. Separator is available in sizes ranging from a unit with a main belt 3 inches wide with one cross belt; to a unit with a main belt 24 inches wide with 8 or more cross belts. For most materials a capacity of 1000 to 1500 lb per hour per ft of belt width is normal. **Magnetic Engineering & Mfg. Co.**, 840 Van Houten Ave., Clifton, N. J.

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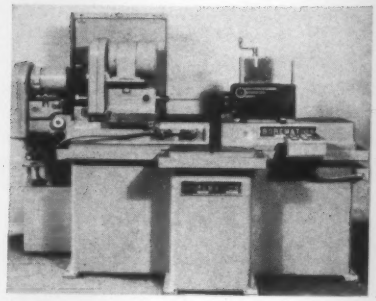
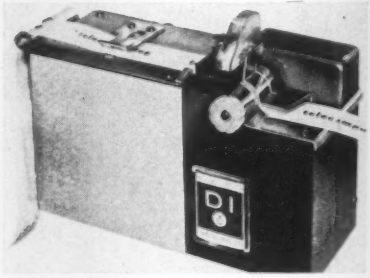


## Gun Drilling Machine

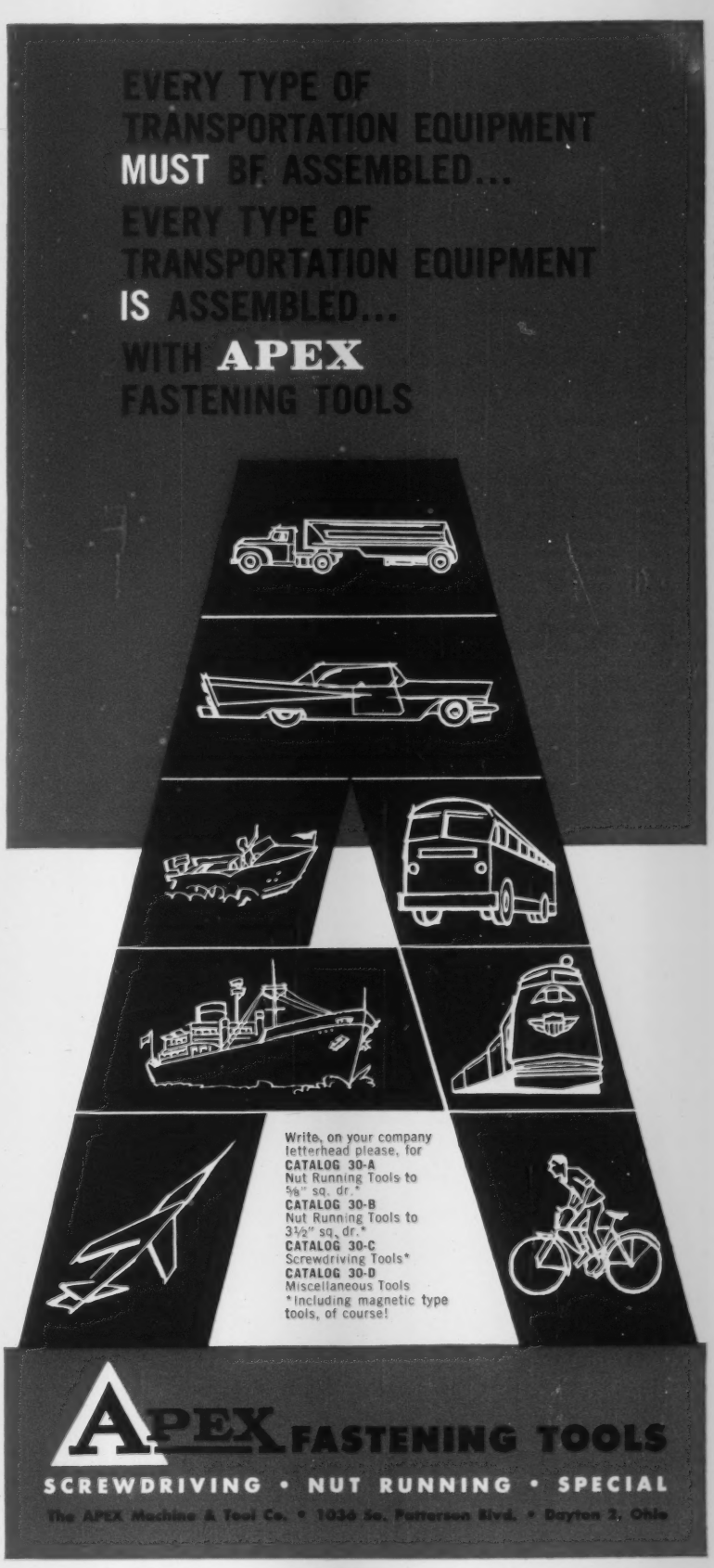
Gun drilling machine produces holes with smooth finishes, maintaining hole tolerances in one pass. Feed range is infinitely adjustable and extends from ½ to 30 ipm. Spindle speeds range from 100 to 10,000 rpm. Unit is available with a 12-inch stroke or a 24-inch stroke. With a mechanical stop attachment, hole depths can be repeated within 0.001-inch with either single, dual, or multiple spindles. **Drillmation Co. Inc.**, 6500 E. Eleven Mile Rd., Center Line, Mich.

*Circle 416 on Page 19*



## Tape Perforator

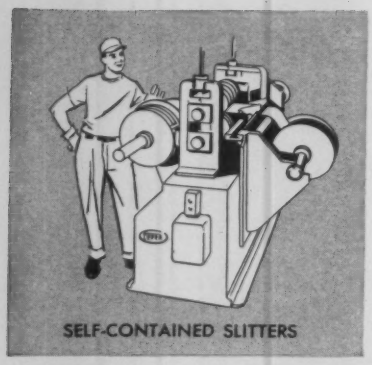
Device has a punching speed of 40 columns per second. Rapid response to punching signals is obtained by an overlap. As the drive shaft completes 180 degrees of the complete revolution required to punch each column, the perforator will accept the signal from the next column to be punched. Tape sizes up to 1-inch in width, and any code column to 8 channels are acceptable. The drive mechanism requires only one eccentric and one cam-generated motion. Another feature of the tape perforator is the four-way staggered positioning of the punching electromagnets. Safety features include an interlock to





*Circle 683 on Page 19*




# YODER SLITTERS

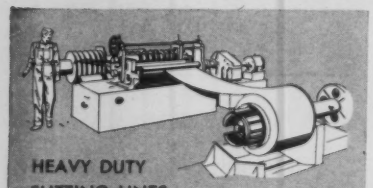
*basic equipment for cost-conscious users of strip!*

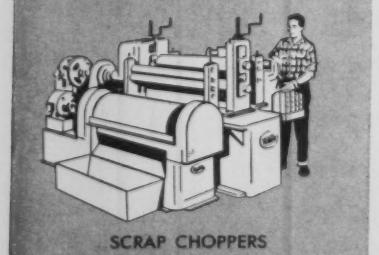
To help meet the demands of tight production schedules, YODER Slitters reduce mill-width stock quickly and economically to desired widths. If your needs are as low as 100 tons per month, time and manpower savings alone will offset the cost of your YODER Slitter in a matter of months, while reducing basic inventories. Compactly designed, standard YODER Slitters are built to handle standard coil widths . . . completely engineered lines for special requirements.

YODER accessories, such as coil cars, swivel unloaders, scrap choppers, scrap disposers, plate levelers and coil boxes, make stock handling fast and easy.

YODER also makes a complete line of Cold Roll-Forming equipment and Pipe and Tube Mills. To profit from YODER'S years of engineering and service experience, contact your local YODER representative or send for the fully illustrated descriptive, YODER Slitter Manual; it's yours for the asking. Write to

**THE YODER COMPANY**
5526 Walworth Ave. • Cleveland, Ohio



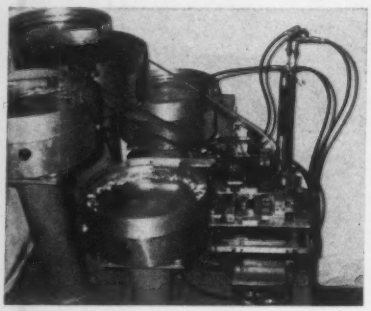




ENGINEERING YODER MANUFACTURING
ROTARY SLITTING LINES

Circle 684 on Page 19


prevent the feed from advancing tape until a column has been punched. A visual alarm indicates low tape supply. Audible alarms are also available. **Data Instruments Div., Telecomputing Corp.**, 915 N. Citrus Ave., Los Angeles 38, Calif.

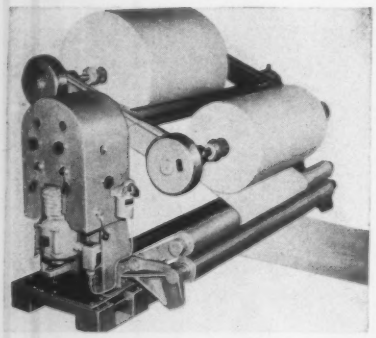
Circle 417 on Page 19



## Parts Feeder

Vibratory parts feeder features a torque motor that vibrates the bowl to feed the parts at the rate of the cycles of the input alternating current. Equipment with the feeder includes a drop cord, switch, and rheostat to control the rate of feed from zero to full capacity. The bowls are made of cast aluminum, magnesium, stainless steel, or plastic. Unit, designated Automator, is available in bowl sizes of 12, 18, 24, and 36-inch diameters. In the illustration shown, five units are feeding an automatic assembling machine. **General Automation**, 538 Toluca Park Dr., Burbank, Calif.

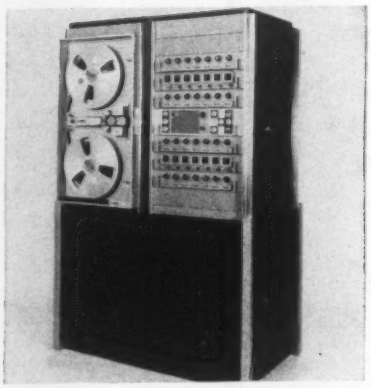
Circle 418 on Page 19



## Unwind & Rewind Stand

Designed for use with continuous roll-stock processing equipment, unwind and rewind stands are capable of handling 18 to 72-inch diameter rolls, operating at speeds of 1000 fpm. Web materials such as paper, plastic films, and foils are suitable. In operation, two rolls of stock are mounted in the unwind unit (Model TO-24) on tandem shafts in a rotatable turret. As the end of the in-feed roll is reached, the turret is rotated, and the second roll is instantaneously spliced onto the moving web without slowing down the process. The empty shaft can be replaced with a new roll of stock. The rewind stand (Model TO-24R) has a turret with dual wind-up shafts which is rotated when the desired cut-off point has been reached. A *flying knife* action of the turret instantly attaches the moving web to the fresh core, permitting the finished roll to be removed at leisure. Features of both units include: Adjustable web width, automatic cut-off knives, power driven turnover, and air chuck. **Stanford Engineering Co.**, Salem, Ill.

Circle 419 on Page 19



## Magnetic Tape Recorder

Analog magnetic tape recorder has low flutter characteristics and wide-band recording techniques for both FM and direct recording. Direct recordings of frequencies as high as 250 kc can be obtained. Model FR-600 has all solid-state electronics. FM, pulse-duration, direct, or digital recording modes are available through plug-in amplifier modules. Both ½-inch and 1-inch tape can be used and it will accommodate either 10½ or 14-inch reels. **Instrumentation Div., Ampex Corp.**, 934 Charter St., Redwood City, Calif.

Circle 420 on Page 19

RIVETT, INC.
TYPICAL APPLICATIONS
Rivett reducing valves
Just released
the "BIBLE" of FLUID POWER!
New authoritative instruction manual describes pressure controlled hydraulic valves—information never before published!

You will find this complete and factual material extremely valuable for planning a modern hydraulic circuit! Written by engineers long experienced in fluid power design, this new 8½ x 11 book shows operations and applications of all pressure controlled valves — relief, sequence, reducing, unloading and counterbalance.

A helpful guide to selecting the proper valve for the job, Rivett's new Catalog No. 230 discusses in detail all factors influencing correct choice: normal spool position, operating pressure source, pilot or direct operation. Also shown are flow diagrams, pressure vs. flow curves, ratings, dimensions, drawings and specifications.

*For your free copy of Catalog No. 230, write on company letterhead to*

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**RIVETT** furnishes a complete power package

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Circle 685 on Page 19

Will a

# SANDVIK STEEL BELT CONVEYOR

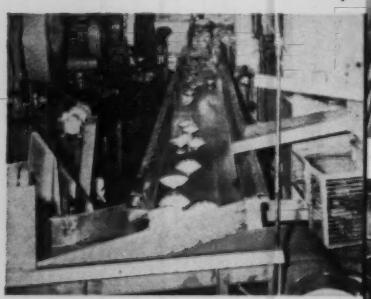
*Improve YOUR Kind Of Automation?*

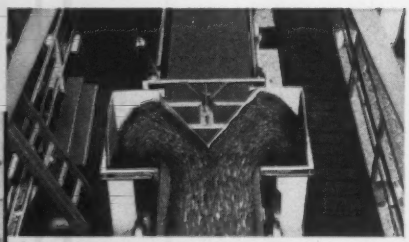
**IT WILL, IF THESE ADVANTAGES ARE IMPORTANT TO YOU.**

- *A strong, impermeable conveying surface of solid steel that —*
- *Resists oil, heat, impact and abrasion*
- *Lets products ride or slide, simplifying live backlogging and automatic discharge.*

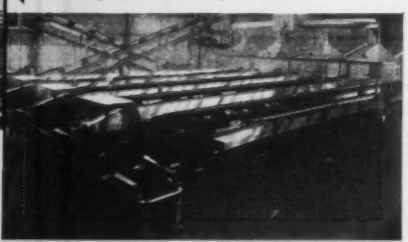
For more information without obligation write or phone your nearest Sandvik office.

Handling Bulk Materials





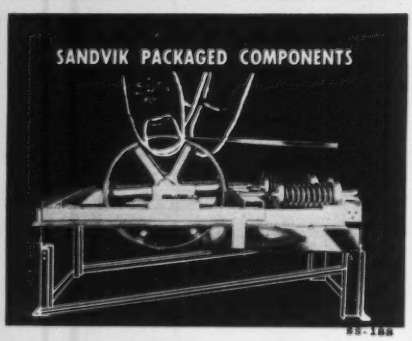
Handling Metal Parts Up An Incline



Sandvik Water-Bed Conveyors Cooling & Solidifying Chemicals

**You Can Buy It Complete Or Build It Yourself With**

In addition to complete, custom-engineered steel belt conveyors, Sandvik supplies conveyor components in packaged unit assemblies. For example, from Sandvik you can buy the tension end assembly, drive end assembly, steel belt, idlers and discharge devices and Sandvik will provide engineering assistance to help you build or convert to a steel belt conveyor.




**SANDVIK STEEL, INC.**

SANDVIK STEEL BELT CONVEYORS

**Steel Belt Conveyor Department**
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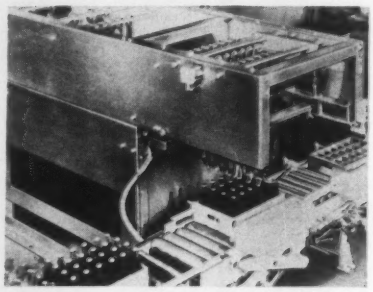
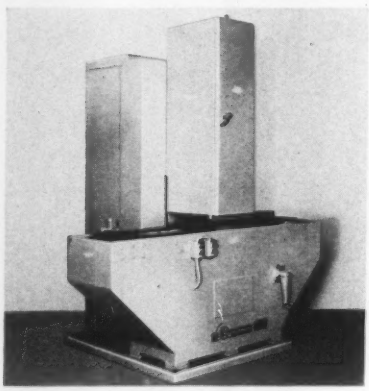
Cleveland • Detroit • Chicago • Los Angeles
IN CANADA:
Sandvik Canadian Ltd., P. O. Drawer 1335, Station O. Montreal 9, P. Q.
**Manufacturers of Steel Belt Conveyors for Over 40 Years.**

## Automatic Bottle Packer

Model S-K 860 is adjustable to different sizes of bottles and patterns of pack. It can load full or half-depth cases with or without partitions, or carry-home cartons. Features of the structurally formed sheet steel unit include: Self-aligning bearings, air-operated pusher plates, and a self-contained drive. Machine is also available in stainless steel. **Portland Div., Emhart Mfg. Co.**, Portland, Conn.

*Circle 421 on Page 19*



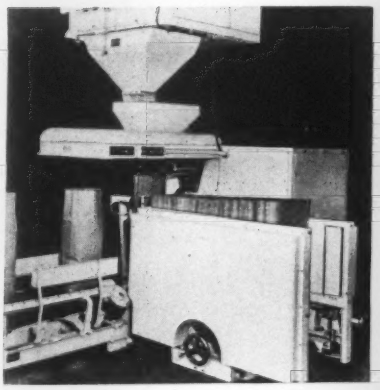
## Abrasive Belt Finisher

Machine is capable of performing abrasive belt grinding, polishing, and deburring operations on flat surfaces of bars, strips, coils, blanks, extrusions, stampings, forgings, die castings, and sand castings on stock up to 15 inches wide and 8 inches thick. It is suitable for parts made of metal, plastic, ceramic, wood, or rubber. Features of the finishing machine include pneumatic belt tensioning, positive automatic or manual belt tracking, micrometer grind pressure adjustment, and a V-belt drive that permits abrasive belt speed changes.

Two styles of finishing machines

are available. Model KC (shown) is a conveyor belt type, has an abrasive belt width of 8 inches. Abrasive belt speeds are from 3200 to 6400 fpm—work feed range is from 15 to 60 fpm. Model KP is a pinch-roll type for square or rectangular tubing and extrusions up to 4 inches thick. Belt speeds and work feed are the same as for Model KC. **Acme Mfg. Co.**, 1400 E. Nine Mile Rd., Detroit 20, Mich.

*Circle 422 on Page 19*



## Bag Feeder/Filler

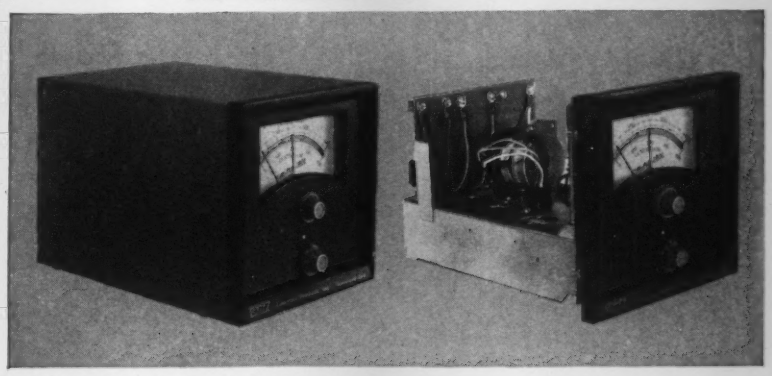
Designed to handle a range of free-flowing products, automatic, open-mouth multiwall bag feeder can operate at speeds of 16 bags per minute. The unit, designated Auto-Mac, feeds bags to a bagholder which receives the discharge of the product from an overhead scale. After the product is discharged into the bag, the feeder automatically delivers the filled bag ready for closing. It will handle a wide range of bag dimensions.

Equipment has two steel arms containing vacuum cups. One arm moves forward to the magazine and draws a bag from a vertical stack. The second arm moves behind the bag and opens it. Two vertical bars, equipped with air operated clamps, then grasp the opened bag at its top edges and lift it on the bagholder. The bagholder holds the bag firmly to the spout during filling. All operations in this cycle are timed by a master drive. Adjustments for bag width and length are made by a handwheel. **Bemis Bro. Bag Co.**, 408 Pine St., St. Louis 2, Mo.

*Circle 423 on Page 19*


**NO TEMPERATURE OVERSHOOT**

**WHEN SIMPLYTROL MINDS THE POT**



**TIME-PROPORTIONING CONTROL HAS UNIQUE ANTICIPATING ACTION**

The new A.P.I. *Simplytrol* brings an extremely high degree of precision to low-cost temperature control. On most applications, this meter-relay-actuated controller will hold temperature accurately to within ±1°F. of a desired set point.

An ingenious anticipating circuit aids in the "pot minding." When the measured temperature approaches the set point, an electrostatic attraction is created between the contacts on the indicating and adjustable pointer-arms. This electrostatic force increases rapidly as the contacts move closer together and causes premature closing of the circuit, thereby avoiding temperature overshoot by early shut-off.

Built around the well-proven A.P.I. meter-relay design, Simplytrol is a complete controller package which uses no amplifying circuits or vacuum tubes: it is perfectly stable, thoroughly reliable. And it costs much less than comparable temperature controls.

Available in thirty ranges from −400°F. to +3000°F., Simplytrol is packaged in an attractive case that converts in minutes from table-top enclosure to panel-mounting rack. Special models offer an adjustable time-proportioning band.

*For complete information, request Data Sheet 9-B.*

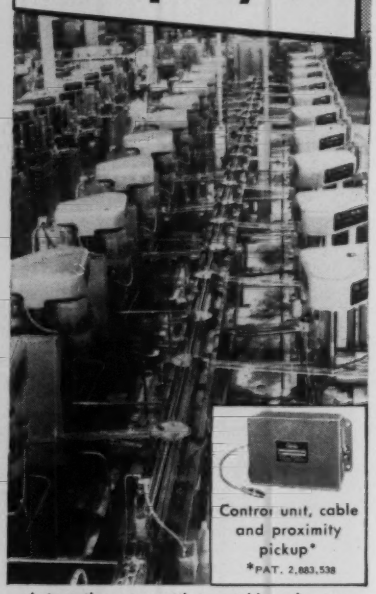
api **ASSEMBLY PRODUCTS, INC.**
**Chesterland 27, Ohio**

S.A. 1894

*Circle 687 on Page 19*

**EPL proximity transducer system* ups gear production**

**1,552,400 units per year!**




Automatic gear cutting machines in one of Michigan's leading automotive plants.

**400% increase over manual feed!**

Automatic gear production line in this plant is monitored by 300 proximity transducers that make stock blank feeding completely automatic. When this system was started in 1957, production figures jumped from 400,000 gears (1956) to 1,922,400 per year.

It's obvious that production increases like this give tremendous savings in time and labor costs. EPL systems can do the same for your operation—investigate today!

**Other Industrial Uses**

• Automatic Production Lines • Conveyors • Parts Feeders • Printing Equipment • Machine Tools • Packaging Machines

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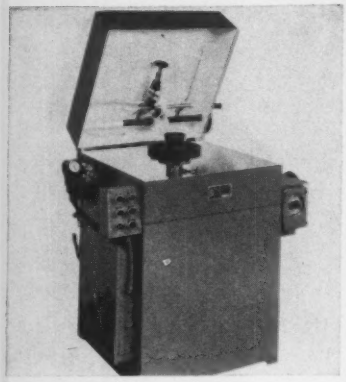
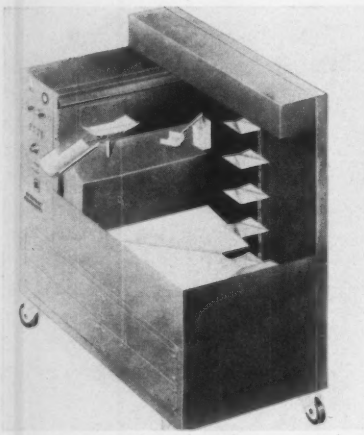
*Circle 688 on Page 19*

## Gear Deburrer

Self-contained unit will remove machining burrs from spur, helical, and bevel gears, regardless of the Brinell hardness of the gear. The operation is automatic except for the loading and unloading of the piece. The work spindle rotates the gear at the desired speed and the floating wheel spindle allows the wheel to automatically follow the gear tooth profile, deburring the entire form. Work speed is 1 to 5 rpm. Maximum wheel speed is 11,000 rpm. Machine is adaptable to low or large lot production runs. **Redin Production Machine Co.**, 2433 Twentieth St., Rockford, Ill.

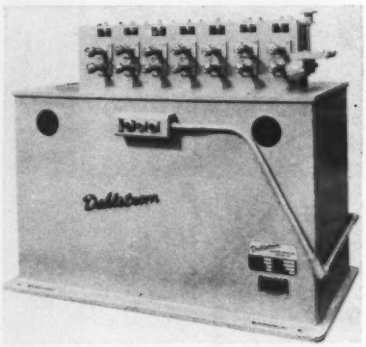
*Circle 424 on Page 19*



## Automatic Parts Counter

Transistorized electronic unit is adaptable to automatic counting of small parts with complex shapes and sizes such as electronic and electrical components, clips, antifriction bearings, and casters. Model 605 operates on the principle of translating weight into exact count. In operation, parts are either batch loaded or fed from a conveyor belt directly into a hopper. The parts are then automatically weighed in groups small enough so that the individual weight variance of each piece will not cause an error in the overall count. The entire number of parts can be counted continuously and a total shown or a certain number of parts can be counted out into preselected group sizes. Part sizes which can be handled range from $\frac{1}{8}$ to 4 inches. Weight limits are from 1/20 of an ounce to one pound per part. **Industrial Products Div., Atronic Products Inc.**, One Bala Ave., Bala-Cynwyd, Pa.

*Circle 425 on Page 19*



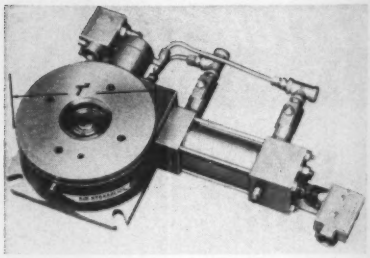

## Roll Forming Machine

Small unit is suitable for roll forming operations to produce parts such as moldings, weatherstripping, and curtain rods. Model 150 features welded steel construction. The spindles, mounted on antifriction bearings, are hardened and ground. Roll diameter range is $2\frac{1}{2}$ to $3\frac{1}{4}$ inches; horizontal center-to-center distance between spindles is 5 inches. Unit is available as an open front type (shown) or an outboard type. **Dahlstrom Machine Works Inc.**, 4227 W. Belmont Ave., Chicago 41, Ill.

*Circle 426 on Page 19*

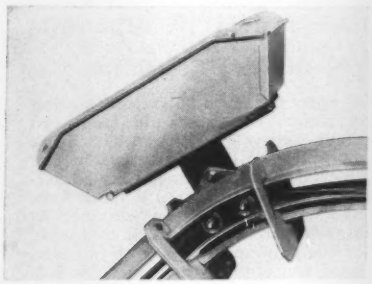
## Index Table

Seven-inch diameter index table can complete up to 75 indexes per minute, will handle a maximum work load of 100 lb. The maxi-



mum power stroke is three times line pressure. To prevent overriding, the indexing cylinder is controlled on the forward stroke by a positive, nonadjustable stop rod. An adjustable stop limits the return stroke. The cylinder also has an adjustable air cushion and an adjustable speed control. A safety feature is that the equipment used with the table is prevented from moving until the table is locked in position by a locking cylinder carrying a limit switch. Model 700 is standard with 4, 6, 8, or 12 stations; up to 24 stations can be provided. **Air Hydraulics Inc.**, 609 Hupp Ave., Jackson, Mich.

*Circle 427 on Page 19*

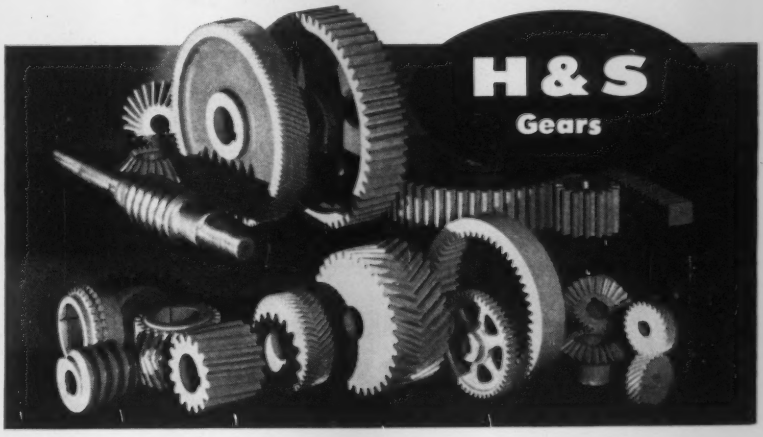


## Pallet Conveyor

Pan or pallet attachments are supported by wheeled trolleys riding between upper and lower tracks. Trolleys are interconnected by rods which terminate in spherical ball bearings. Horizontal and vertical curves may be followed. Each trolley has eight wheels. Four wheels on horizontal axles roll on either the lower tracks or the upper hold-down tracks. Four wheels on vertical axles roll against side rails on horizontal curves. With this design, the trolleys do not pitch or yaw, even with loaded pallets or pans attached to them. **Conveyor Div., American MonoRail Co.**, Fourth & Franklin Streets, Tipp City, Ohio.

*Circle 428 on Page 19*

**Gears and Speed Reducers**
**for your power transmission needs**




H & S offers a complete line of Speed Reducers. Single, double and triple reduction types using Herringbone and Helical gears provide ratios from 2.31 to 1 up to 429 to 1; Worm gear reducers' ratios range from 3.56 to 1 up to 10,000 to 1. H & S has also become a leader in engineering and building special drives with space- and cost-saving features.

Industrial Gears, large or small, backed by over 70 years experience: Spur Gears up to 160" dia.; Spur Racks up to 12 ft. long; Helical Gears up to 125" dia.; Sykes Herringbone, up to 60"; Straight Bevel, up to 77"; Worm Gears up to 60" dia.; Sprockets, up to 48" dia. H & S Gears are available in Steel, Cast Iron, Ductile Iron, Bronze, Rawhide, Fibroil, or Bakelite.

*Send for Speed Reducer Catalog No. 55, Gear Catalog No. 57.*

**THE HORSBURGH & SCOTT CO.**
**GEARS AND SPEED REDUCERS**
**5112 Hamilton Avenue • Cleveland 14, Ohio**

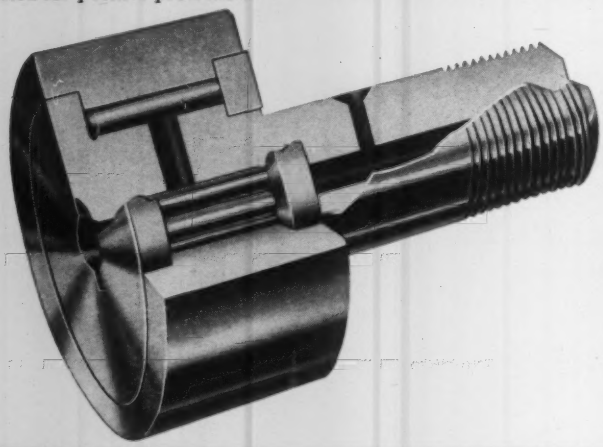
*Circle 689 on Page 19*

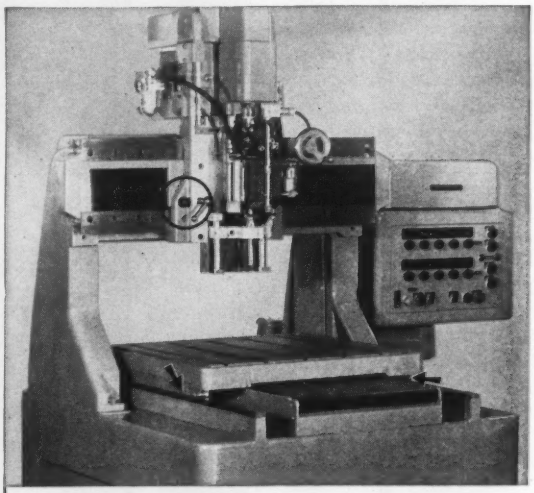
**AUTOMATION TIPS**
by McGill

# CAMROL® bearings... provide automated machinery with precision anti-friction - extra capacity - longer life

Specify CAMROL cam followers where you need dependable, maintenance free bearing performance in automated machine operation. They offer engineered precision with extra protection against jolting wear and excessive loading.

Built especially for cam, guide, support or track roller applications, the McGill cam follower provides free rolling action, positive side thrust and low starting friction — all available in roller sizes from ½" to 4". Order the CF (with stud) and CYR (for shaft mounting) sealed for positive protection.





## Sealed CAMROL Bearings as table and crosshead rollers in tape-controlled Hillyer drilling machine

CAMROL bearings provide smooth, accurate motion as load carrying rollers for table and crosshead motion of this tape-controlled, precision drilling machine manufactured by Hillyer Corporation. Use of the sealed CAMROL bearings has greatly simplified construction and improved accuracy. They have eliminated the manufacture of shaft and retainer assemblies and increased load capacities. The corrosion resistant finish of the SCF series bearings has also eliminated the need for plating the bearings. Ball bearings formerly used in this application cracked under the same loads. High accuracy of shaft and bearing concentricity eliminates the need for separate adjustments. Operating speeds are 400 RPM and loads are 2000 pounds. The bearings are prelubricated and sealed to keep maintenance at a minimum.

## CAMROL bearings take cam action shock in FMC juice extractors

The Food Machinery and Chemical Corporation In-Line Juice Extractor uses McGill CYR-3 bearings as cam followers on the vertically reciprocating beam that carries cups for squeezing juices from citric fruits. A large cam having an 11" total throw drives against the bearings, moving the beam downward. The CYR 1½ cam followers are used to pull another beam upward. The upstroke is a power stroke with 6" total throws.

Both cam followers have stood up exceptionally well. Many have been in the field for 6 years and operated 20,000 hours, or the equivalent of at least 48 million strokes.

*engineered electrical products*

**McGILL**

*precision needle roller bearings*

SEND FOR CATALOG No. 52-A

**MULTIROL — GUIDEROL — CAMROL**

McGILL MANUFACTURING COMPANY, INC., BEARING DIV. 401 N. LAFAYETTE ST., VALPARAISO, IND.

# AUTOMATION new components

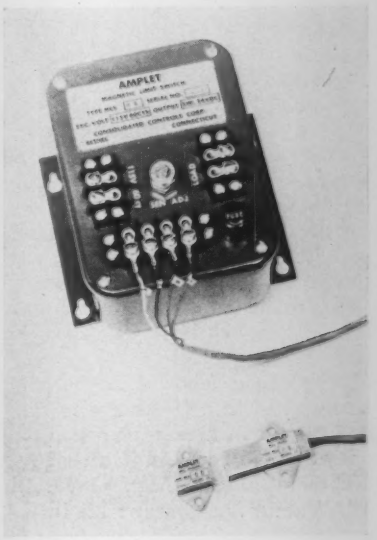
Parts, elements and devices designed for creating more automatic systems.

For detailed information and literature, use card page 19.

## Magnetic Limit Switch Has Snap Action

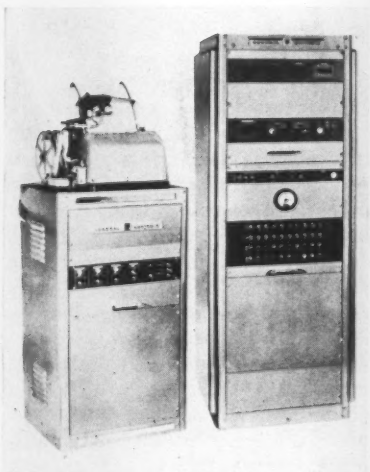
ACTUATED by the approach of a magnetic trigger, magnetic limit switch is particularly suitable for automatic applications where precise control of the relative motion between two parts of a machine is required. Some of the applications include: Limiting cuts or traverse on machine tools such as shapers, planers, and drill presses; stopping conveyors at predetermined positions; continuous sequencing and counting, and automatic weighing and filling. The switch, designed by **Consolidated Controls Corp.**, Bethel, Conn., consists of three parts —a probe, which is normally mounted on a stationary part of the machine, a magnetic trigger, which is mounted on a moving part of the machine or on the part being machined, and a power amplifier, which increases the power output of the probe to useful levels.

In operation, the probe gives an *Off* signal until the permanent magnet trigger approaches within a predetermined distance. The probe is connected by wire to the power amplifier, but the trigger has no wired connections. When the predetermined distance is reached, the probe gives the electrical equivalent of a snap action to an *On* signal condition. Response time to this action is less than 1 millisecond. By adjusting a sensitivity control on the power amplifier, the distance at which the action between the probe and trigger takes place is variable from 0.020 to 0.200 inch. When the motion is reversed, the *On* signal remains until the trigger has moved away from the probe—a distance varying from 0.002 to 0.02 inch. At this point, the *Off* signal is restored. Power input to the unit at full load is seven watts




of 115v, 60 cycle ac. The output signal is 50 microamperes in the *Off* condition and five watts of 24v dc in the *On* condition.

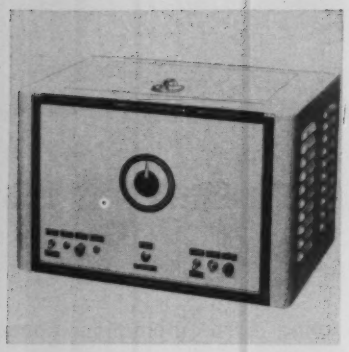
*Circle 429 on Page 19*



## Remote Flow Data Recording

Automatic control system designed for well testing consists of a data receiving central (left) and a data accumulation and transmitting control (right). The controller can test up to 40 wells in sequence, and report by wire to the receiving station. Data can be recorded from up to 800 wells in 20 leases scattered over thousands of miles. In operation, the controller accumulates test flow data from the lease test separator, and at the conclusion of testing any well, it signals the data receiving central that it has information to report. On the return signal from the central, the transmitter reports the lease, codes the well number as indicated by the well test control, and then sequentially reads the counters. This gives the length of the test to 0.01 hour, total flow of gas in cfm, and oil and water in barrels. Three-position switches permit automatic sequenced testing of wells; skipping of any wells, and manual control when desired. **General Controls Co.**, 801 Allen Ave., Glendale, Calif.

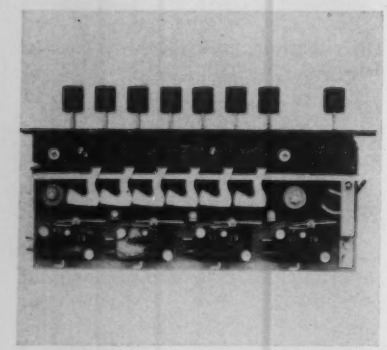
*Circle 430 on Page 19*



## Circuit Tester

Automatic circuit tester is capable of checking up to 52 circuits for high potential breakdown, correctness of wiring, and (100 megohms) insulation resistance of cable and harness assemblies. The analyzer uses quick disconnect terminal boards for rapid adaptation of testers to specific hookups. After the circuit selector pin points the fault and it is noted, the operator can continue testing the remaining wires by actuating the fault override switch. Unit is furnished in two styles—Model HC-52S and Model HC-52 (shown). Either can be mounted in a 19-inch relay rack or installed in a case for bench top operation. **Programation Div., Guardian Electric Mfg. Co.**, 1621 W. Walnut St., Chicago 12, Ill.

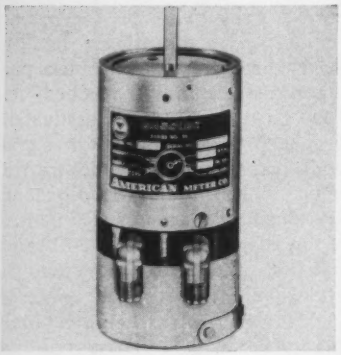
*Circle 431 on Page 19*



## Code Bar Switch

Feature of code bar switch is that the input is by octal or decimal pushbuttons and the output is by binary-coded contact closures. Conversion to binary code is performed by cam-type code bars. Binary coded outputs are in the form of limit switch contact closures with double throw contact arrangements. A mechanical interlock permits only one pushbutton key to be depressed at a time by automatically releasing any previously depressed button. The over-all switch dimensions permit stacking to form complete keyboards. Switch is available in three styles. Model DS-1 has a ten-button decimal bank with 1-2-4-8 binary output contacts. Model OS-1 has an eight-button octal bank with 1-2-4 binary output contacts. Model OS-2 has an eight-button octal bank with 1-2-4 binary output contacts plus a single pole double throw switch coupled to the zero pushbutton. **Western Div., Computer Control Co. Inc.**, 2251 Barry Ave., Los Angeles 64, Calif.

*Circle 432 on Page 19*




## Gas Powered Time Drive

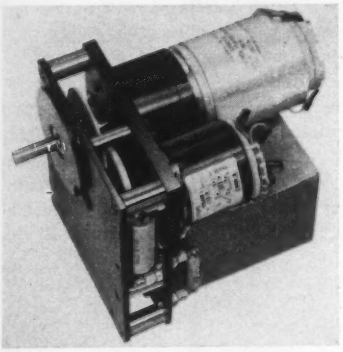
Designed for operation in remote installations, air or gas powered drive can be used as original or replacement equipment in all makes and types of recording instruments requiring chart records from one-hour to 30-day periods. This includes units such as integrating orifice meters, strip chart recorders, gas lift meters, pressure recorders, telecounter units, and field program timers. Unit is explosion-proof and internally sealed to prevent corrosion or clogging. All parts exposed to gas are made from aluminum or stainless steel. It has a gas or air consumption of 5 cfh at a normal operating pressure of 5 psi. Clock can be mounted in any position and its accuracy is not affected by wide fluctuations in supply pressure. **American Meter Co.**, 920 Payne Ave., Erie, Pa.

*Circle 433 on Page 19*

## Thyratron Tube

Device has an xenon filling which minimizes tube voltage drop and features a rugged button stem to insure immunity from mechanical failure. Carbonized nickel grid is used to minimize grid current. Alumina ceramic insulators are used throughout the tube to provide strength and high insulation resistance. **Electronic Tube Div., Westinghouse Electric Corp.**, P. O. Box 284, Elmira, N. Y.

*Circle 434 on Page 19*



## Servo Repeater

Designed to follow the position of a remote synchro, instrument can be used to drive an indicator or other data elements such as a pot or resolver. When coupled to an encoder, it becomes a servo driven digitizer. It can also be used as a chart drive or a computing element. Model 770A consists of a servo motor, gearing, control transformer, and servo amplifier. An output driver shaft is also provided. Output shaft speed is 120 rpm; maximum output torque, 30 oz. in.;

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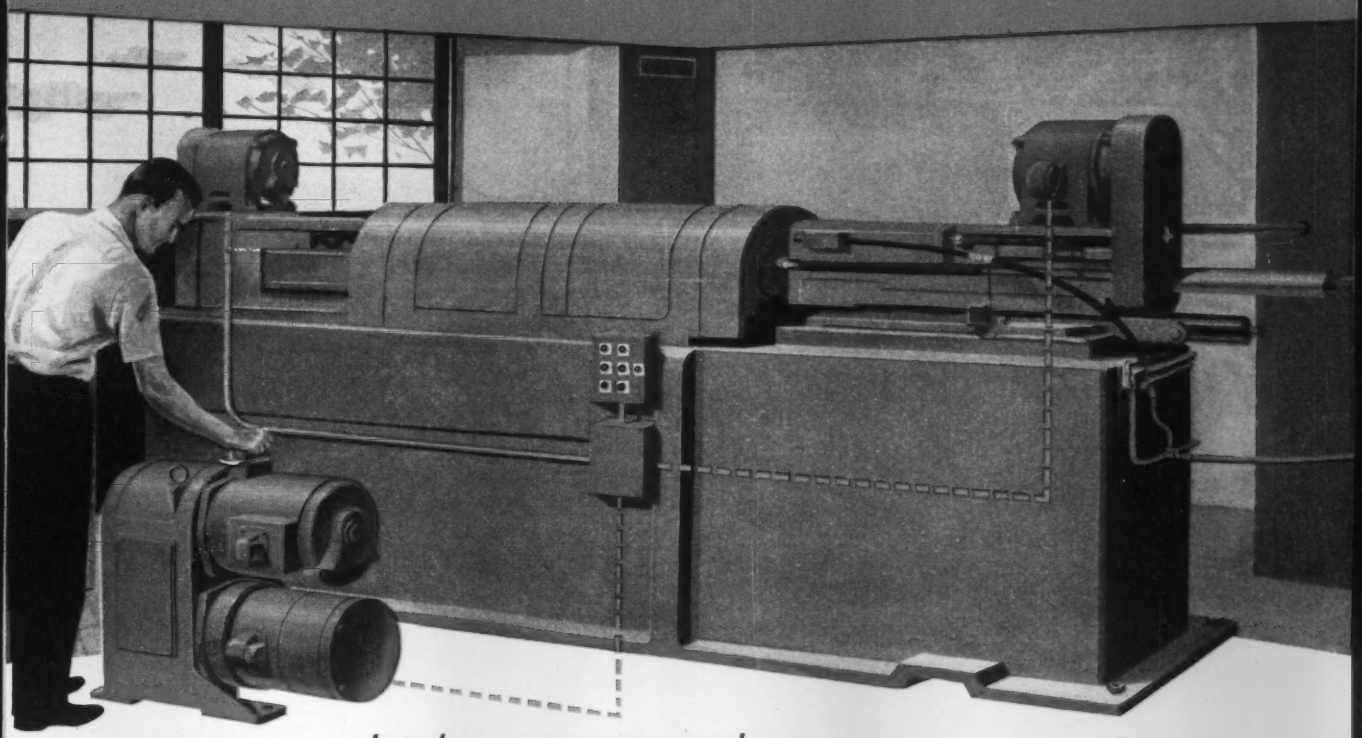

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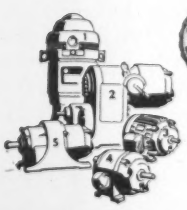

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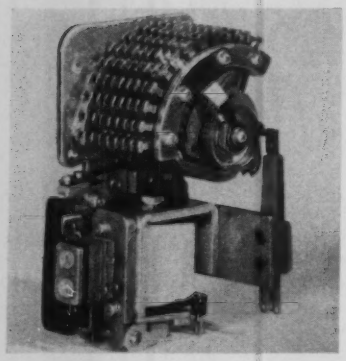
Circle 691 on Page 19

torque gradient, 3.2 oz. in. per degrees. Operating temperature range is −55 to 75 C. Unit operates from 117 v 400 cps line. **Industrial Control Co.**, 805 Albin Ave., Lindenhurst, L. I., N. Y.

*Circle 435 on Page 19*



## Stepping Switch

Spring driven stepping switch will accommodate twelve 11-point levels and up to four 33-point levels. It can operate for approximately 100,000,000 steps between adjustments. Device, designated Type 211, features heavy duty armature bearings and arms; is designed to have a long service life and require a minimum of maintenance. **C. P. Clare & Co.**, 3101 Pratt Blvd., Chicago 45, Ill.

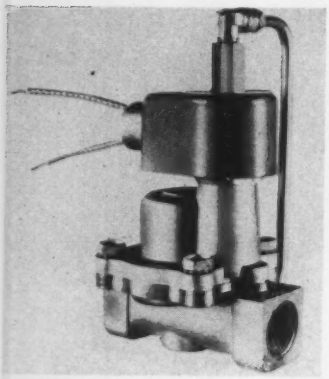
*Circle 436 on Page 19*

## Pneumatic Transducer

Suitable for installation between control computers and existing pneumatic equipment, transducer will convert a dc voltage or milliamp signal to a pneumatic control signal. Adjustment is provided for input ranges from 0.25 to 2.5 v to 1 to 10 v. Output ranges are between 0 to 1.5 psig to 3 to 15 psig. The unit responds to input change of 0.05 v, has a dead time of 0.02 seconds and a full range time of 1.25 sec. Linearity and hysteresis deviations are less than 1 per cent.

In operation, a voltage signal from a feedback transmitter senses the output pressure of the unit. It is compared with the input signal. Unless the signals are equal, a closed loop servo system makes necessary corrections until the output air pressure is proportional to the input signal. Model 106 will operate on 117 v ac, uses a supply pressure 1.2 times the maximum output pressure. It is suitable for ambient temperature range from zero to 150 F. **Associated Control Equipment Inc.**, P. O. Box 136, 853 Fourth Ave., Coraopolis, Pa.

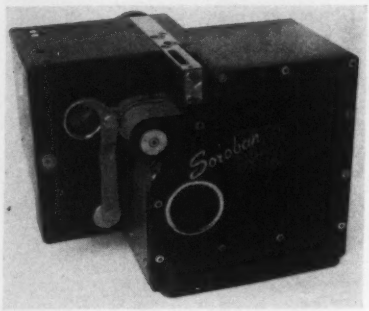
*Circle 437 on Page 19*



## Solenoid Valve

Two-way, normally open solenoid valve can handle steam, hot gases, and light liquids up to 350 F. It is available in $\frac{3}{8}$, $\frac{1}{2}$, and $\frac{3}{4}$-inch pipe sizes. The valve can be used to control the flow of steam to turbine driven generators or as a tripping device on emergency power plants. It can also be used wherever the valve is required to open upon power failure or when the valve solenoid is de-energized. Unit has forged brass bodies and bonnets. Renewable teflon discs provide tight seating at pressures to 125 psi. Valve can be mounted in any position, and the solenoid enclosures can be rotated 360 degrees for electrical installation. **Automatic Switch Co.**, Hanover Rd., Florham Park, N. J.

*Circle 438 on Page 19*



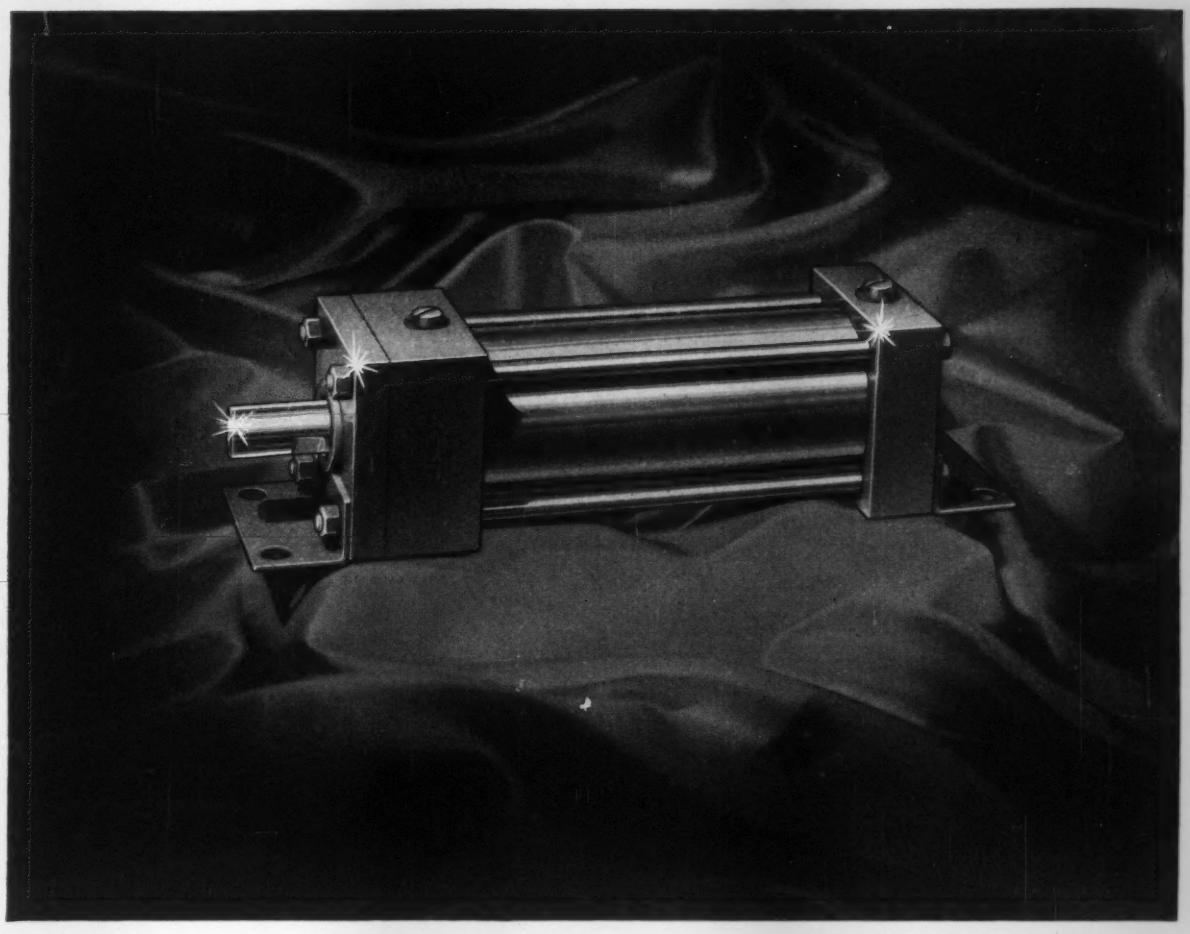

## Tape Perforator

Device can punch up to 300 coded characters per second on standard communication paper or Mylar tape. Basic recording cycle permits 1/3 of a cycle for tape transport and 2/3 for pin penetration of the tape. The tape transport system operates from a cyclic motion containing stationary periods at both extremes of its stroke. The stationary periods provide intervals for coupling and decoupling the drive. Unit executes a single tape punching and feed cycle, or any repetitive number of such cycles. Lubrication for the internal parts of the punch is by a splash oil bath system. **Soroban Engineering Inc.**, Box 1717, Melbourne, Fla.

*Circle 439 on Page 19*

## Viscosity Controller

Indicating unit is suitable for applications where viscosity control is required, but a permanent record is not needed. Controller is for use with company's measuring elements which operate on the principle of measuring the time required for a piston to fall a given distance through the solution to be measured. The indicator and indicating controller can be located a distance



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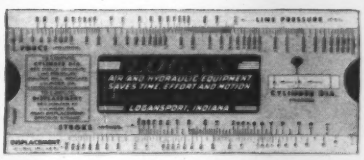


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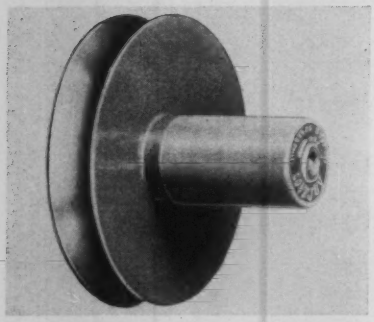
*Circle 692 on Page 19*

from the measuring element and can be furnished with high and low viscosity alarms. **Norcross Corp.**, Dept. N69, Newton 58, Mass.

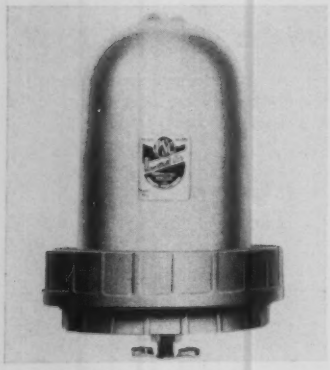
*Circle 440 on Page 19*



## Variable Speed Pulley

Pulley can change speed instantly with finger-tip pressure while a machine is in motion. It can provide ratios up to 3:1 at 3⅓ hp at 1150 rpm or 5 hp at 1750 rpm. Each pulley face is independently actuated by its own spring, but both move simultaneously and equally to give constant belt alignment. Curved pulley faces maintain full contact with belt sides to provide maximum efficiency. Model 3050 uses a 1 13/16-inch top width variable speed belt. Motor travel for full range is 4⅝ inches with 9.53 inch maximum and 3.17 inch minimum pitch diameters. **Lovejoy Flexible Coupling Co.**, 4984 W. Lake St., Chicago 44, Ill.

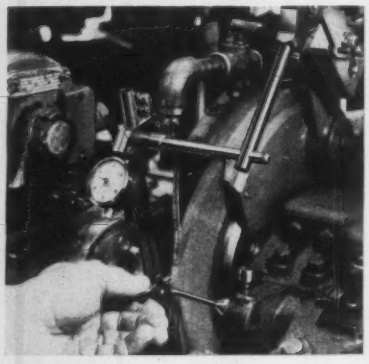
*Circle 441 on Page 19*



## Air Line Drain Trap

Drain trap can be used on compressed air lines to machines and air equipment to discharge condensate and oil at a rate of 60 gph. When installed in air lines, it prevents filters, regulators, and equipment from becoming water-logged. The orifice and valve seat are self cleaning and a blow-off valve is provided for periodic removal of rust and residue. The trap body and bowl are aluminum and the valve mechanism is of stainless steel and brass. Unit is available in ¼-inch NPT. **Perfecting Service Co.**, 332 Atando Ave., Charlotte 6, N. C.

*Circle 442 on Page 19*



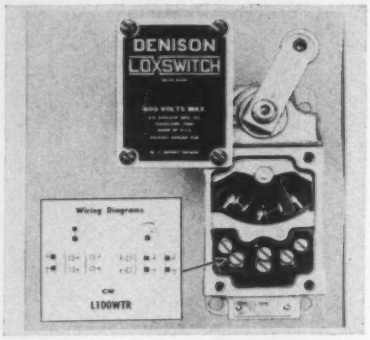
## Miniature Grinding Gage

Continuous grinding gage (Model SG) has adjustable calipers ranging in size from 0.093 to 0.500 inch. For special applications, calipers as small as 0.060 inch can be furnished. The gage is designed so it will not exert forces that could distort the work. The main weight of the gage is located close to the supporting hub pivot point to reduce its influence on the gaging contacts. The supporting hub assembly has a wide lateral adjustment for mounting the gage on the grinder and a super-sensitive ball bearing mounting for following the work size as the metal is removed. An air gage head can be installed on the same frame for automatic control. **Federal Products Corp.**, Providence 1, R. I.

*Circle 443 on Page 19*

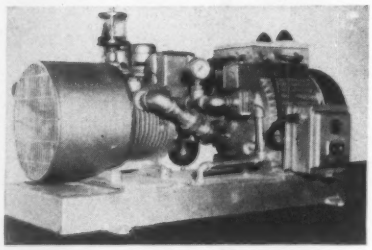
## Three-Circuit Switch

Limit switch is designed to permit various circuit arrangements. It can be used in safety interlock systems to tie together two or three




functions; or to control a motor and simultaneously start or stop a timer or other control. Two styles of switches are available. Model L100WTR (shown) is suitable for clockwise operation with two normally open and one normally closed circuit. Model L100WTL is suitable for counterclockwise operation with two normally open and one normally closed circuit. Both styles are reversible to give one normally open and two normally closed circuits. They have a ¾-inch conduit opening for wires. They also have 70 degrees safety overtravel in both directions. **R. B. Denison Mfg. Co.**, 102 St. Clair Ave., N. W., Cleveland 13, Ohio.

*Circle 444 on Page 19*



## Vacuum Power Unit

Unit supplies a source of vacuum, providing automatic control for handling nonporous products such as plates, blocks, slabs, and tubes. Device, designated PP300 Powerpac, includes, a self - contained pump, motor, automatic delayed action reserve system, and a solenoid operated 5-way control valve. It can deliver 50 cfm free air and vacuum to 28 inches hg. Safety features include a vacuum gage and signal lights to indicate safe lifting. **Vac-U-Lift Co., Div., Siegler Corp.**, Salem, Ill.

*Circle 445 on Page 19*

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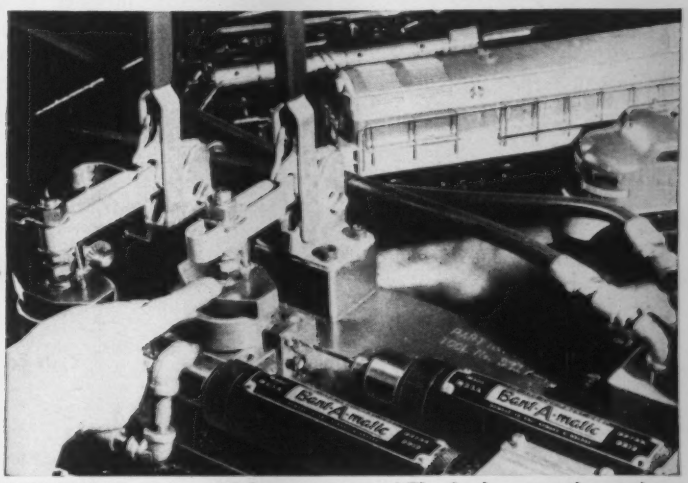


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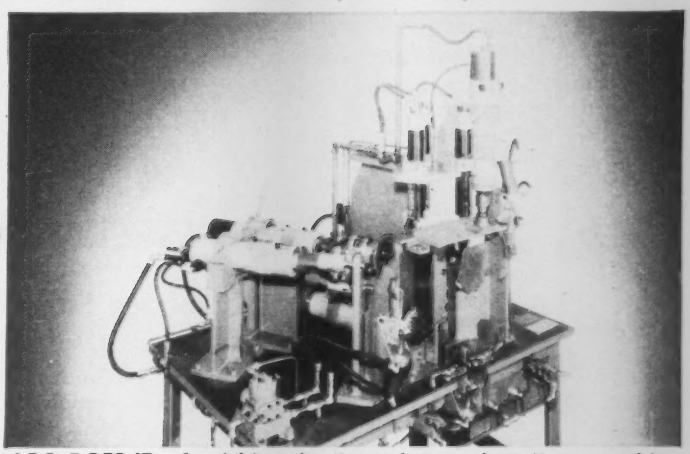

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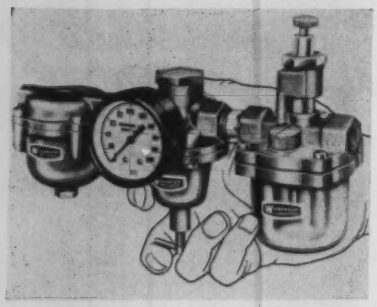
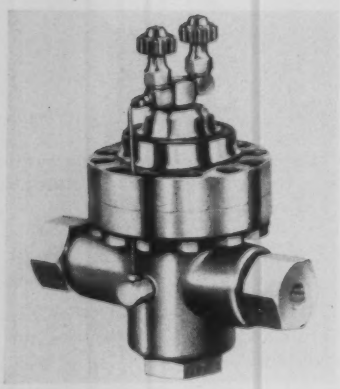
*Circle 693 on Page 19*



## Miniature Air Line Control

Combination separator, regulator, and lubricator is suitable for all compressed-air operated equipment. The separator activates with each cycle of the air, automatically discharging the accumulated moisture and sludge into the atmosphere. The regulator is self-relieving and is equipped with three outlet ports. It is available with pressure ranges from zero to 50 psi and 5 to 125 psi. It can also be equipped with a tamperproof adjustment. The lubricator will start lubricating at one cfm and will deliver an oil fog to as many tools as the air will serve. It automatically increases and decreases the oil fog according to air demands. With a metal bowl on the lubricator, operating pressure is 5 to 250 psi. **Wilkerson Corp.**, 1552 W. Girard, Englewood, Colo.

*Circle 446 on Page 19*



## Pressure Regulator

Unit is adaptable for high flow regulation of noncorrosive gases and liquids. Regulator is available in two styles. Model GD100 (shown) is furnished with valve and orifice sizes from $\frac{3}{8}$ to $\frac{3}{4}$-inch, with AN tubing or pipe connections. Outlet pressures rise 1 to 4.5 psi per 100 psi of inlet decay, depending on orifice size. Maximum flow is 20,000 scfm.

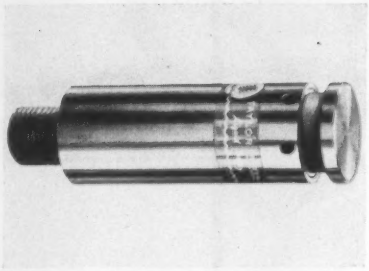
Model GD200 has a $1\frac{1}{2}$-inch orifice; is compensated to provide constant outlet pressure as inlet pressure decays. Connections can be either 1500 lb ASA flanges for 3600 psi applications at ambient temperatures, or 2500 lb ASA flanges for 6000 psi applications. Maximum flow is 50,000 scfm. Both styles operate at maximum inlet and outlet pressure up to 6000 psi, with a proof pressure of 12,000 psi and an operating temperature range of −67 to +250 F. **Victor Equipment Co.**, 844 Folsom St., San Francisco 7, Calif.

*Circle 447 on Page 19*

## DC Voltage Standard

Applicable for computer reference, field calibration, test equipment, and potentiometric circuits, dc voltage standard (1.0000 v) has a revolutionary regulation of one millionth of one per cent for any change in ac input voltage from 90 to 150 v. Any output voltage change over this range is less than 1 mu v. Temperature coefficient of the solid-state unit is 5 to 20 parts per million per degrees Centigrade from −65 to +125 C. Device can operate in any position and will maintain a stable output under severe conditions of shock, acceleration, vibration, temperature, and humidity. It is available with any output voltage up to 5 v for 60 cycle or 400 cycle input, any wave shape. **Jackson Electronic & Mfg. Co.**, 695 Johnston St., Akron 6, Ohio.

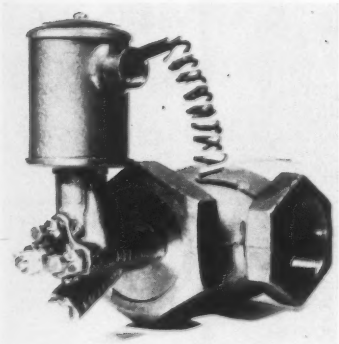
*Circle 448 on Page 19*



## Liquid Spring

Model 1028 uses liquid compressibility, can provide a preload from 500 to 5000 lb, and can also be used as a shock absorber to relieve excessive loads on structures or tools. The spring force increases 200 lb with each ten thousandths of an inch stroke plus dampening forces of 6000 lb, and maximum energy absorption of 1500 in.-lb. One of the uses of the liquid spring is in fabricating dies which reduces the number of single-purpose dies and the number of drilled and tapped holes. **Taylor Devices Inc.**, 188 Main St., North Tonawanda, N. Y.

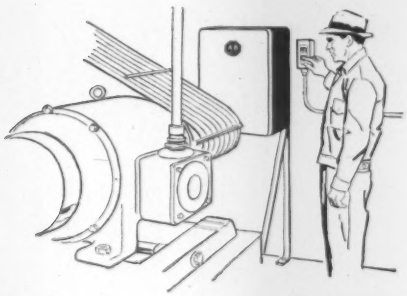
*Circle 449 on Page 19*



## Solenoid Valve

Device has four independent controls for the adjustment of the opening and closing speeds, flow control, and for manual operation in the event of power failure. Features of Model HV include: Built in filter in the control head, heavy duty coil assemblies, unbreakable piston rings, and guided pilot valves to insure positive seating with minimum wear. **J. D. Gould Co.**, 4707 Massachusetts Ave., Indianapolis 18, Ind.

*Circle 450 on Page 19*



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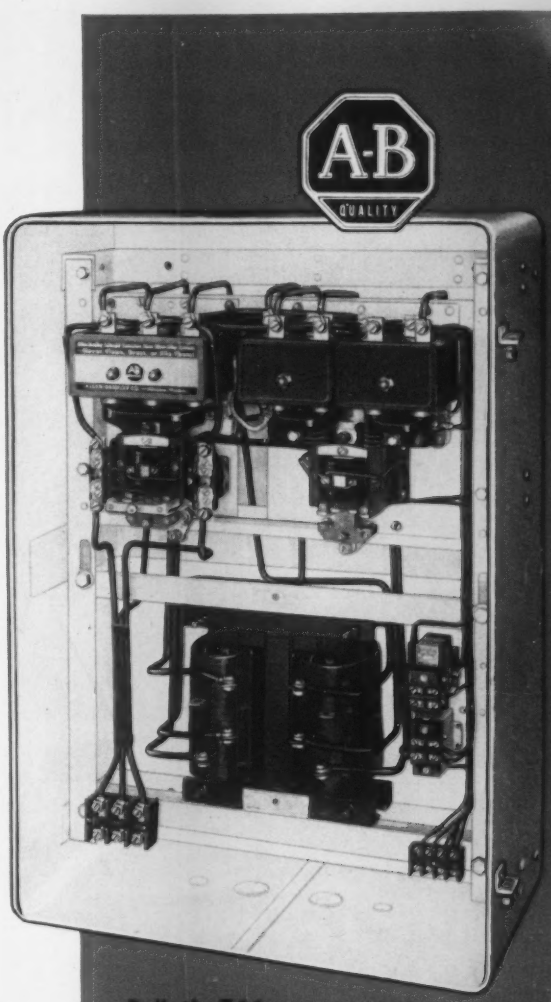
## Only Allen-Bradley can provide all the answers

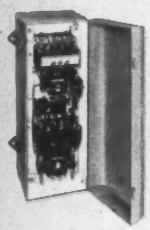
The Allen-Bradley line of reduced voltage starters makes possible a selection of the best starter, not only to meet the power company's requirements but also to provide the best starting conditions for the motor and the "load" that it drives.

The simple solenoid contactors in A-B reduced voltage starters have only ONE moving part—assuring millions of trouble free operations. And their double break, silver alloy contacts never need costly maintenance. Accurate, reliable overload relays protect motors against burnouts. Write for Publication 6088.




**Bulletin 746**

Automatic reduced voltage starter for squirrel cage motors that should not be started on full line voltage. It employs autotransformer connected in open delta to reduce line voltage during starting. Adjustable timing relay controls starting period. Taps are provided on the autotransformer to adjust the starting voltage applied to the motor. Ratings to 300 hp, 220 v; 600 hp, 440-550 v.

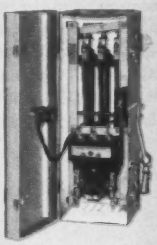


**Bulletin 740**

Graphite disc resistors are automatically inserted in series with the squirrel cage motor at starting, and they are automatically cut out after a predetermined time. Turning a single screw on the starter frame adjusts the compression resistors exactly to motor and load conditions for velvet smooth acceleration. Ratings to 200 hp, 220-440-550 v.

**Bulletin 640**

Where remote control is not needed, these graphite compression disc resistor starters provide stepless acceleration of squirrel cage motors. Operated by hand lever, the smooth starting of the motor is under the control of the operator. No-voltage and dependable overload protection is provided. Ratings to 200 hp, 220-440-550 v.



Allen-Bradley Co., 1339 S. First St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

# ALLEN-BRADLEY

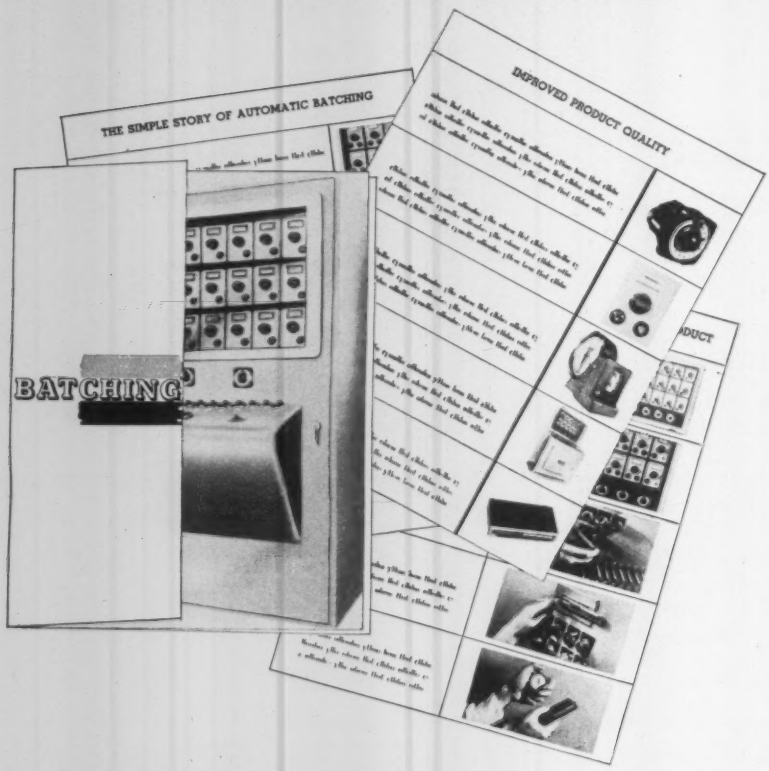
Member of NEMA

*Quality* Motor Control



Circle 694 on Page 19

# AUTOMATIC BATCHING HANDBOOK




## EVERYTHING YOU NEED TO KNOW ABOUT AUTOMATIC BATCHING

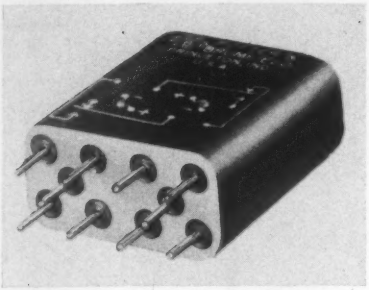
- HOW TO DO IT
- HOW MUCH IT COSTS
- WHAT YOU NEED
- HOW TO USE WHAT YOU HAVE
- HOW TO SELECT THE RIGHT SYSTEM

**If you are now combining two or more ingredients in any kind of formula or batch, write now for this new *free* automatic batching handbook. It describes in detail how automatic batching works, how to convert existing plant facilities or plan new plants for automatic operation. It illustrates the latest batching systems available, lets you select the right type for your particular needs. Also shows you how to combine materials handling equipment, storage facilities, and weighing equipment for greatest economy, increased production. This is the newest, most complete handbook on automatic batching available—be sure to write for your free copy today!**

HOWE

THE HOWE SCALE CO. • RUTLAND, VT.
A SUBSIDIARY OF SAFETY INDUSTRIES, INC.

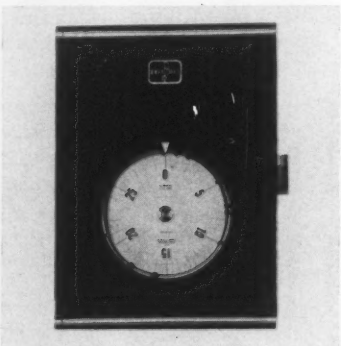
Circle 695 on Page 19

## Micro-Miniature Relay

Line of micro-miniature relays features terminals located on 0.2 by 0.2-inch co-ordinates to facilitate mounting on printed circuit boards by automatic assembly techniques. The layouts are available on both dual coil magnetic latching and on single coil action relays. Unit operates under 100g shocks and 30g vibrations to 2000 cps with no contact openings in either armature position. Relays with single coil action pull in at 260 milliwatts at 25 C; dual coil latching relays pull in at 230 milliwatts. Contacts are rated 2 amp, 28 v dc, resistive. **Potter & Brumfield Inc.**, Princeton, Ind.

*Circle 451 on Page 19*



## Time-Cycle Controller

Designed for processes based on timed operations, instrument (Model CIC 500) can time control as many as ten different variables for applications such as the operation of tire presses, dyeing, water conditioning, and batch processes. Ten pilots (pneumatic, electric, or a combination) can be operated simultaneously or in any sequence. Each pilot can perform up to 24 operations. Dogs set on the periphery of

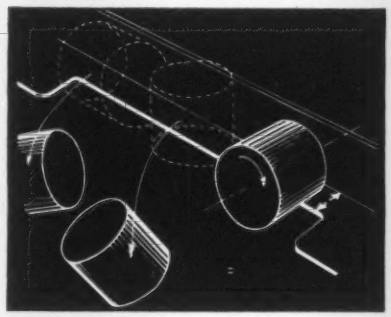
# practical automation ideas....no. 3

### Storage Unit that Thinks for Itself!

When should a part be stored temporarily between operations? When should it pass immediately to the next operation? A Gear-O-Mation storage unit makes this decision after checking if the loader is full. It either positions the part on the loader for immediate processing, or puts it in "storage" for later demand feeding.

### Impossible!—But it Works!

An orientor that repeals the law of gravity? Impossible? Maybe, but Gear-O-Mation has one that's hard to believe.



Parts roll down an "L"-shaped track which narrows to *slightly less than one-half width of part!* Correctly rolling parts roll on across for further processing; others just tumble off and go back to the start of the track.

**What's your concept of automation? A vast array of inter-connecting machining operations untouched by human hands? Actually, all automation comes down to a series of small devices—feeders, orientors, escapements, conveyors, etc. Dozens of typical devices are illustrated in Gear-O-Mation's "Idea File". Ask your Gear-O-Mation field engineer to show you his.**

### Magnetic Handling with Fabric Belt

Small irregular shaped parts can be elevated or directed into orientors with fabric belts backed by permanent magnets in such a way that only those correctly positioned will enter the demand-feed chute.

### Single Loader for Multiple Feeder

Where it is desired to load parts into a multiple feeder (as for a heat-treat oven) they can be picked off a single chute, dropped into a multiple "Velvet-Drop" (patented) feeder which keeps all channels of the multiple feeder loaded, provides temporary storage to keep them full.

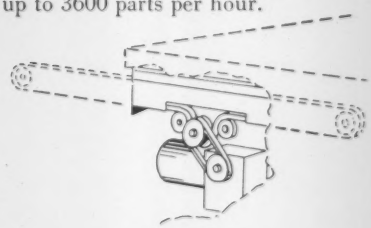
**Most people think of automation as something built into the original installation. That's a good way to do it, but you don't have to do it that way. If you want to automate your existing operation this can be done very effectively, too. In either case, Gear-O-Mation's experts can automate your machining operation to any degree desired—make it deliver all of the potential designed into it.**

### Track: Fast, Clear and Adjustable!

A simple answer to handling parts of different dimensions—as when a design change is made—is an adjustable-track conveyor. Side plates and rails are moved in or out, quickly adjusted for smaller or larger part width. Parts roll on spring steel rails. Soils, chips, cuttings, etc., fall through, making the conveyor self-cleaning.

### One Belt Does Two Jobs

Sometimes you can use the same belt to unload parts from one machine and load them into another by using a center drive gear head motor with a wrap-on sprocket. A typical Gear-O-Mation installation of this type handles up to 3600 parts per hour.



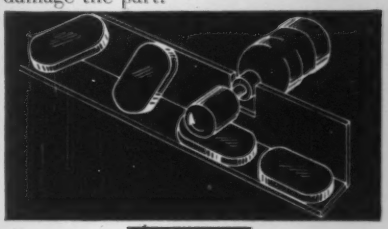
**Automation begins with the coupling of two machines, often through a simple elevator and a gravity chute. From this you can go almost to infinity. Gear-O-Mation has the experience and ingenuity to point the way and design the equipment for the exact degree of automation your operation requires and warrants.**

### Handling Parts in Pre-Set Groups

In automation, parts don't have to be handled one-at-a-time only. Sometimes it works better to process them in groups of preset quantities, using a feeder that meters and releases the precise number required. For example, in one plant, eight plastic fishing reels are aligned and placed on a spindle for simultaneous group winding.

### Pencil Wheel Orientor

A small grinding wheel can be used to orient light parts by knocking down all parts which try to pass in an upright position. The light 'bite' of the wheel gives positive action but does not damage the part.



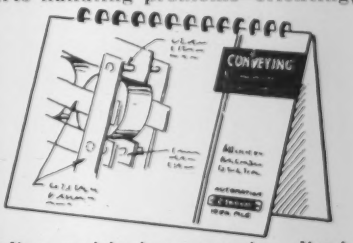
**Gear-O-Mation doesn't believe in its customers having to pioneer untried ideas. Where a new principle is involved, we make sure of it first. Mostly, however, we go back to established principles we all KNOW will work.**

### Demand Storage for No-Roll Parts

Where parts can't roll you can move many rows of them through storage by a simple, moving disc with fixed guide rails. One such Gear-O-Mation unit collects, stores and feeds up to 3000 small parts.

### NEW "IDEA FILE"

**Every Gear-O-Mation field engineer now carries with him an "Automation Idea File." It contains sketches and details of practical answers to many parts handling problems—orienting,**




**feeding, positioning, conveying, distributing, etc. These ideas will suggest variations to suit your exact needs. Have a Gear-O-Mation field engineer go through the "Idea File" with you soon! Use the handy coupon below.**

**GEAR-O-MATION**
DIVISION OF MICHIGAN TOOL COMPANY
7171 E. McNICHOLS RD. • DETROIT 12, MICH.

GEAR-O-MATION
Division of Michigan Tool Company
7171 E. McNichols Rd., Detroit 12, Mich.

Yes! I want to see the time- and money-saving ideas in your new "Idea File." Have your field engineer show it to me soon!

Name_____
Company_____
Street_____
City_____



*Circle 696 on Page 19*

**FOR**

**GREATER**

**"SMALL-TUBE"**

# reliability

**... replace with RCA "Premiums" and "Special Red" Tubes**

Recommended wherever increased reliability of small-tube circuitry is important. Characteristics are uniform throughout useful life. Rigid controls and rigorous tests weed out "early failures". Designed and built to give dependable performance under conditions of shock and vibration. Available at RCA Industrial Tube Distributors.

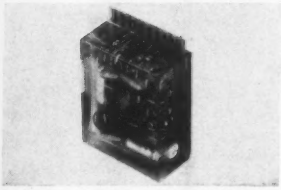
RCA **RADIO CORPORATION OF AMERICA**
*Electron Tube Division* *Harrison, N.J.*

Handy data book RIT-104-A includes the tube characteristics you need to know when you install RCA "Premium" and "Special Red" Tubes. Free, from your RCA Industrial Tube Distributor.

*For the name of your nearest RCA Industrial Tube Distributor, call Western Union by telephone and ask for Operator 25.*

the timing disc determine the timing of pilot operations. Intervals between operations can be as brief as four seconds. Timing discs range from 0-15 minutes to 0-360 minutes. **Bristol Co.**, Waterbury 20, Conn.

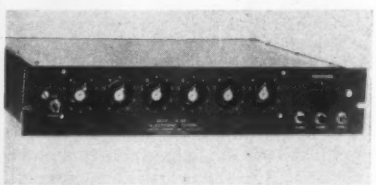
*Circle 452 on Page 19*



## Liquid Level Control

Sensing instrument for monitoring and measuring liquid levels is especially suitable for liquefied gas (cryogenic) control. Other applications include fuel gaging, process liquid control, and quantity control and inspection. Instrument consists of a transistor module (heart of the device), connecting cable, and a control assembly which contains the power supply. During a loading operation, the transistorized sensing element will tell if gas is in its liquefied rather than its gaseous state. The sensing system is designed for a distance of as much as two miles beween the probe and control-power unit. The probe is available in three styles—shielded, nonshielded, and flush. **Trimount Instrument Co.**, 3119 W. Lake St., Chicago 12, Ill.

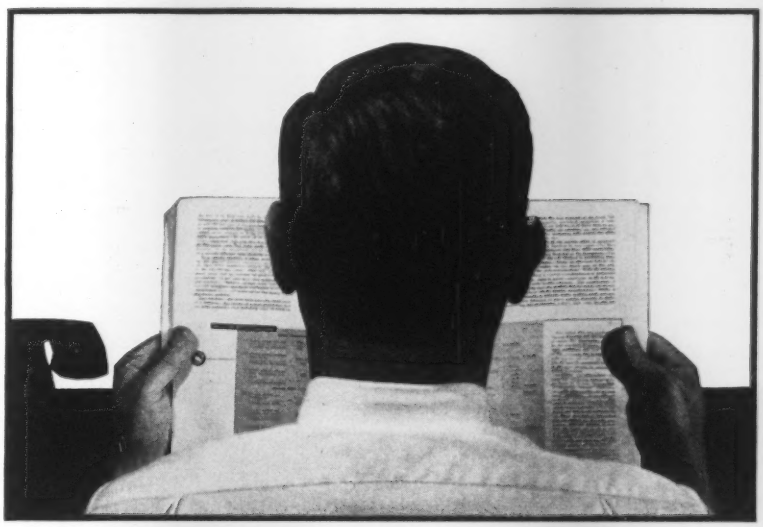
*Circle 453 on Page 19*



## Electronic Timer

Designed for use with company's automatic printer scaler, timer can also be used separately. The glow-tube type unit is driven from a stable 100 or 1000 cycle oscillator. The cycle is selected by a front panel switch. It has a preset time from ½ second to 10,000 seconds in steps of ½ second, 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, and 10,-

# $1000 REWARD



## For the capture of this man's ATTENTION

This is the opportunity you've been looking for—a chance to create a really effective businesspaper advertisement.

### YOU CAN EARN $1000

To satisfy this long-time, deep-felt urge—and earn $1000 in the bargain—send us copy and a rough layout for *one* advertisement (any size, color or not, as you see fit). This ad should be capable of attracting the interested attention of industrial advertisers with a stake in the automation market. It should point up the values AUTOMATION magazine holds as a medium for reaching buyers of automatic production equipment.

### MORE THAN ONE WINNER

This is not a one-winner contest. AUTOMATION will pay $1000 to the creator of each advertisement it decides subsequently to use as part of its advertising campaign. AUTOMATION editors will be the judges. Contestant's identity will remain anonymous during the judging.

### FOR HELPFUL BACKGROUND INFORMATION

Pertinent information about AUTOMATION's market, readers and objectives for use in preparing your entry appears on the back of this page. If you desire additional material, please write and we will send you a booklet supplying complete details.

### DEADLINE IS NOVEMBER 30, 1959

The competition is open to all. Anyone with a creative flair is urged to try his skill. Yours may be just the idea we're looking for. Send completed entries to $1000 Reward, c/o AUTOMATION, Penton Building, Cleveland 13, Ohio.

# Background Information to Help You Win

# $1000 REWARD

(For complete contest details, please see reverse side)

### The Marketing Man's Stake in Automation

Automation is the marketing man's challenge today—and in the future. His ideas *must* match this manufacturing concept. The creative marketer realizes that as an absolute first condition, automation requires the establishment of a predictable, stable, and expanding market. Economic and sociological pressures force automation on us; automation forces new marketing concepts on us.

The building of a constant market will require a more complete circuit of communication. Now, the manufacturer-customer flow of information largely goes from the maker to the buyer. But with automation, we will have to know more about what the customer wants. Needed are improved ways to get better communication from maker to user and then back again.

### The Management Man's Stake

Automation, or continuous automatic production, naturally will grow out of more complete mechanization. We have progressed from the manual area through the mechanization area and are now well into automation. Any discussion about whether automation is desirable is a futile intellectual exercise. We might as well argue whether the tides and the seasons are desirable.

The dawn of mechanization at the turn of the century brought a new era of lower costs and a higher standard of living than would have been possible in a manually operated economy. Now, we are approaching the upper limits of cost and labor reduction possibilities in a mechanically operated economy. We need a new breakthrough—and it will come through automation.

In the words of D. S. Harder, former Executive Vice President, Basic Manufacturing Divisions, Ford Motor Co.

> "Time has proved that the machine age is a boon—not a bugaboo . . . Manufacturers, large and small, have to make a choice. They can heed the warnings of uninformed doom prophets and retard our industrial progress—a road leading to oblivion. Or we can all have faith in ourselves and our ability to harness the potential of this new phase of industrialization for the benefit of all."

### The Manufacturing Engineering Function

When industry first backed into automation without precision engineering, it had plenty of trouble. As a result, the manufacturing engineering function developed and has become industry's fastest growing and most important buying influence for automated production equipment.

Industry is changing from a departmentalized approach to a three-phase approach.

PHASE ONE—the processing or work-performing phase, which includes all the steps that alter or combine materials.

Phase Two—the handling phase, which encompasses the movement of materials in process within or between machines.

Phase Three—the control phase, covering the automatic cycling of functions 1 and 2—either independently or integrated.

### How AUTOMATION Serves This Function

Edited for men with *manufacturing engineering* interests and responsibilities . . . AUTOMATION serves all industries. It reports and interprets all significant advancements and trends relating to automation, including planning, development, design, installation and maintenance. It provides for the exchange of ideas from one industry to another. This cross fertilization is the time-and-money saving link between those who have solved a production process problem and those who are still looking for a solution.

### Why Users Read AUTOMATION

AUTOMATION is directed particularly to manufacturing engineering and operating management men in industry who are responsible for, or directly interested in, automation. Editorial and advertising pages provide the basis for their decisions concerning the adoption or improvement of automated equipment and manufacturing systems for their own use.

### Why Designers and Builders Read It

In addition, AUTOMATION appeals to engineers and management men in companies that serve the special automation needs of industry . . . the manufacturing engineering function *to* industry. It gives designers and builders specific job help relating to all types of automated original production equipment . . . from single automatic machines to fully integrated lines and plants.

### Reaches a $5 Billion Market

A continuing industry-wide study pinpoints the tremendous potential for Production Equipment, Handling Equipment, Power Drives and Automatic Control Equipment in this vast market controlled by the manufacturing engineering function. This "Survey Report and Automation Forecast" provides you with a new measure of marketing trends. Ask your AUTOMATION Representative to show you how to incorporate its data into *your* marketing plans.

### Attracts a 90,000 Buyer Audience

AUTOMATION's vital readership is concentrated among 90,000 key buying influences . . . the manufacturing engineering and management men who specify, recommend, approve and buy your products. It reaches the important influences of the buying team . . . the men your salesmen don't always get a chance to contact and, yet, would *prefer* to contact.

### High Response to Editorial

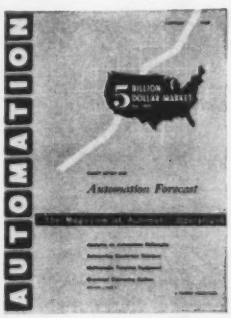
Written by manufacturing engineers for manufacturing engineers . . . AUTOMATION is geared to the exact needs and wants of its readers. Its editorial pages clearly communicate—create respect and response! This high level of reader interest is documented by reprint requests (averaging over 130,000 annually) and continually high Starch readership scores.

### High Response to Advertising

Every advertisement in AUTOMATION is directed to the manufacturing engineering function, production-management men, or the designers of production equipment. No waste circulation . . . for every reader has the *need* to know about these products and the *power* to buy them.

### Market Planning Help

You get more effective results from your advertising and help in reaching key automation-minded men in industry, too, with a complete marketing plan which includes: The Penton Census . . . the Continuing Industry-Wide Study of Automation . . . Reader Action Reports . . . Market Data Sheets . . . Starch Scores . . . plus many other Merchandising Aids. Your AUTOMATION Representative is prepared to help you make the most of industry's fastest growing and most influential function—*manufacturing engineering.*




**Get ACTION from the men who buy and specify . . .**

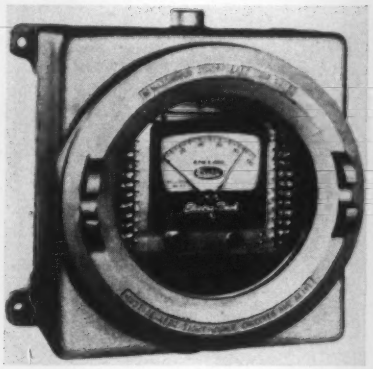
- *Production Equipment*
- *Handling Equipment*
- *Power Drives and Automatic Control Equipment*

**AUTOMATION**

A Penton Publication
Penton Bldg., Cleveland 13, Ohio

000 seconds. Provisions are made for elapsed time measurements to 1000 seconds, or to 10,000 seconds. Timing accuracy of the rack mounted timer is better than 1/10 of 1 per cent per day. This is limited only by oscillator stability. **Hamner Electronics Co. Inc.**, Princeton, N. J.

*Circle 454 on Page 19*



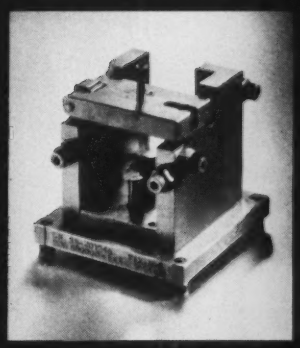
## Tachometer

Transistorized tachometer has a twofold function—it can measure speed without physical contact and control associated circuits for over speed and under speed. A magnetic pickup is the sensing device for the tachometer. Angular velocity of shaft projections or a rotating gear induce a signal in the pickup corresponding to frequency of revolution. The pickup's signal is converted by the tachometer to a dc current directly proportional to the frequency of the pickup's signal.

The meter in Model 7120 has two pointers. One indicates rpm; the other (a control pointer) can be set to any desired value of rpm prior to making a measurement. When the pointer indicating rpm reaches the value at which the control pointer has been set, a mechanical and electrical contact between the two pointers is made. This results in the activation of the relay used for controlling associated circuitry. The relay contacts are connected to a front panel male receptacle or terminal strip to facilitate connection to the circuitry being controlled. Unit will operate on 117 v ac, 60 cycles. **Electro Products Laboratories**, 4501 N. Ravenswood Ave., Chicago 40, Ill.

*Circle 455 on Page 19*


Tooling with tape...

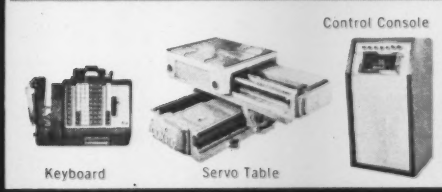


This drill jig: $280.00

This drill jig: $4.20

you can see the profit in point positioning with DIGIMATIC* model 202 Point-Positioning System

**Ask us to arrange a demonstration** with **your** parts.
Write for free 12-page booklet, "DIGIMATIC MODEL 202."
Also—movies shown at your shop or plant on request.

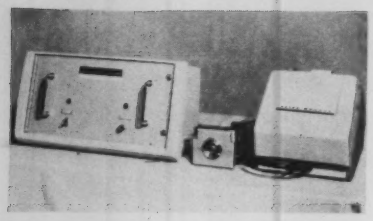



The lowest-cost complete point-positioning system for drilling, tapping, reaming, spot facing

*DIGIMATIC IS OUR TRADEMARK

STROMBERG-CARLSON
A DIVISION OF GENERAL DYNAMICS
1495 N. GOODMAN STREET • ROCHESTER 3, NEW YORK

*Circle 697 on Page 19*



## Automatic Logging System

Digital logging system is capable of providing a digitized output from potentiometer recorders or shaft inputs. The output can be up to three decimal digits (0-999). The readings can be initiated automatically by an external contact closure from a timer, clock, or on demand. Model K-120 is made up of a hollow shaft, shaft position-to-digital encoder, a control unit, and a printer.

The system can obtain data while a shaft or recorder is continuously following, or stopped. On the fly readout is obtained because the encoder position is stored in the control unit within 40 milliseconds of a readout actuation. When the *Record* pushbutton on the front of the control unit chassis is actuated, the system will print data, or when a contact is closed across an external circuit. The control unit stores the coded output from the encoder and provides necessary contacts and controls to operate the printer. Printing is done on adding machine tape. **Datex Corp.**, 1307 S. Myrtle Ave., Monrovia, Calif.

*Circle 456 on Page 19*


**MOLINE**

**FOR GREATER PRODUCTION • EFFICIENCY • SAVINGS**

*Use rugged, reliable "Hole Hog" machine tools for such jobs as:*

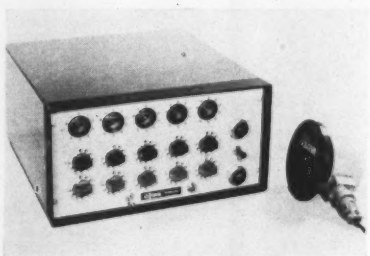
★ Multi-Spindle Boring ★ Single and Multi-Spindle Honing
★ Straight Line Multi-Drilling ★ Adjustable Spindle Drilling
★ Vertical and Way-Type Fixed Center Drilling, Boring and Tapping
★ Special Multiple Operation Machine Tools

Twenty-Station, Ten-Unit Transfer Machine for boring, counterboring, chamfering and valve clearance operations on V-8 automotive engine blocks. (Shown)

Over 58 years of MachineTool Engineering experience is at your service. Tell us your particular problem.

MOLINE TOOL COMPANY
100 20TH STREET • MOLINE, ILLINOIS
*REPRESENTATIVES IN PRINCIPAL CITIES*

*Circle 698 on Page 19*

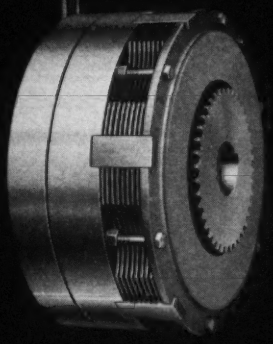
## Length Controller

Suitable for automatic cutting-to-length applications transistorized controller can be connected to all types of shearing mechanisms which are initiated by a relay closure. In operation, sensing devices are connected to measuring wheels to mechanically convert material length into a proportionate shaft rotation. Simultaneously, the sensing device converts this rotation into corresponding pulse signals (up to 2400 counts per rotation). Then the pulses are fed to the digital length controller for numerical display of linear travel and actuation of the cut-off mechanism when material reaches the exact length to be cut-off. This length has been predetermined on the instrument panel. In the event of a material breakage, the controller can stop operation and actuate a warning alarm.

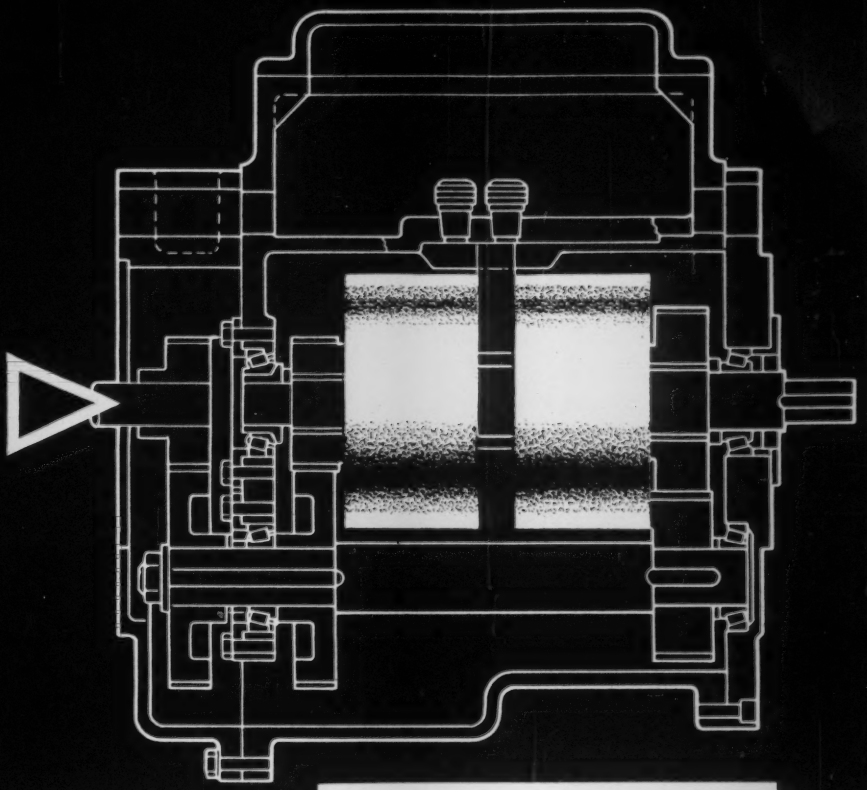
Optional equipment is available for the controller. Length change-over control provides instant changeover to a new length with a single lever switch. Automatic time delay compensator eliminates errors by compensating for fixed delay of shearing time at widely varying material travel speeds. An automatic sequencing control system uses two or more controllers for batching and multiple control functions such as shearing steel strips


**ACRO WELDER MFG. CO.**
MILWAUKEE
WELDING ENGINEERS
MACHINERY BUILDERS
ESTABLISHED 1936

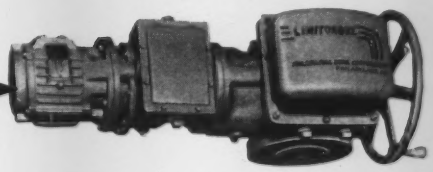
*Circle 699 on Page 19*



# Fawick Magnetics Here...



Philadelphia Gear Limitorque Valve Control with Hi-Lo attachment provides two-speed valve operation.



# produce two-speed valve action HERE!

FAWICK Magnetics play an important part in operation of the two-speed Hi-Lo attachment used by Philadelphia Gear Corporation on their outstanding Limitorque Valve Controls.

The Hi-Lo attachment is an automatic-control transmission, mounted between the drive motor and the Limitorque assembly and is equipped with two FAWICK SC Magnetic Clutches. It provides for changes in opening and closing speeds, with optional high speeds in one direction and slow speeds in the reverse direction. Slow speed for partial travel in one direction—with the remainder at high speed—may be accomplished with adjustable limit switches.

The many operating advantages provided by FAWICK Magnetics make them particularly adaptable to both standard and highly specialized power transmission applications. Instant response to controls; full power, accurate control of torque output; smooth, shock-free engagement; and long service-free operating life are but a few. For full information call or write your nearest FAWICK representative or the Home Office, Cleveland, Ohio.

**FAWICK AIRFLEX DIVISION**
**FAWICK CORPORATION**
9919 CLINTON ROAD • CLEVELAND 11, OHIO
Fawick Canada, Ltd., 60 Front St., West, Toronto, Ont., Canada

FAWICK MAGNETIC
INDUSTRIAL CLUTCHES AND BRAKES

*Circle 700 on Page 19*

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Machine speed — not worker efficiency — governs production on automatics equipped with Lipe Automatic Machine Loading Bar Feed. That's because Lipe takes over the tedious, back-breaking hand-loading — leaves the machinist free to concentrate on quality . . . machine set-ups . . . care of tools.

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automatically and continuously feeds stock of practically any length, shape or material in close-tolerance feedouts. Users report production increases of 40% . . . 90% . . . even 200% per machine, plus labor benefits that are even more important. We'd be glad to give you a fair estimate of what Lipe can do for you. Just send prints of samples or some typical work.

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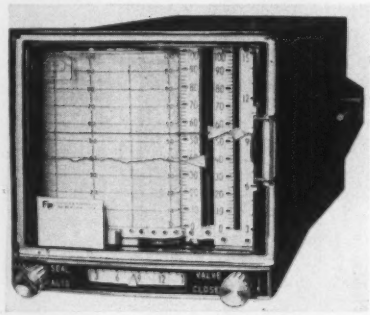
PIONEERS IN PNEUMATIC BAR-FEEDING

Circle 701 on Page 19

at various lengths, actuating a punch press to pierce various numbers of holes in each strip, and counting the number of sheets in each batch for the next controller in the cycle to take over. **Dynapar Corp.**, 5150 Church St., Skokie, Ill.

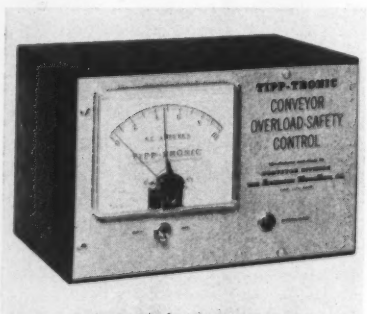
Circle 457 on Page 19



## Strip Chart Recorder

Four inch strip chart recorder and controller features a modified inking system which provides a full month's record without refill. Re-inking is accomplished without interfering with the movement of pen parts. Another feature of the instrument, designated Mark III, is a flip switch for reversing controller action from air to open to air to close. Recorder also has a plastic door for visibility, built-in damping of pneumatic input signals, fused chart motor, fourteen hour visible chart record, and interchangeable indicating and recording chassis. **Fischer & Porter Co.**, 143 Jacksonville Rd., Hatboro, Pa.

Circle 458 on Page 19




## Overload Control

Overload-safety control can be used on any type of conveyor with

## For complete chain drives ¼" to 2" pitch . . .

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.81" to 50.94" P.D. SPROCKETS, iron and steel, for single ROLLER CHAIN

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**DOUBLE PITCH ROLLER CHAIN**
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**BORED-TO-SIZE**
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Complete with keyway and setscrew. ⅜" through 1" P., in 86 pinion sizes, with 360 stock bores

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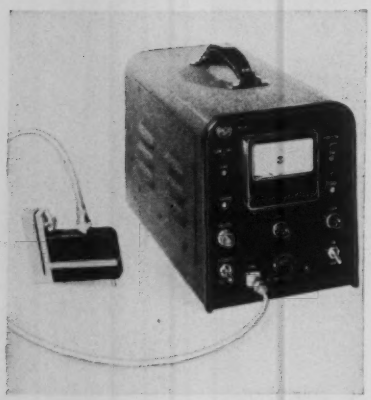
Circle 702 on Page 19

## SPEED-UP ACCURATE INSPECTION AND SORTING!



## NEW RCA LIMIT-SIGNALING COMPARATOR

*for both contact and air gaging*

The RCA LSC Comparator speeds up accurate manual checking and sorting since the operator only has to observe the high, low, and OK limit lights. Ideal for incoming or production line inspection. Extremely reliable and accurate to .000,050".

**INSTANT RESPONSE**
Operates on RF frequency. No lag between contact with work and meter indication.

**FAST, EASY SET-UP**
Gage is linear over full scale, making it a simple matter to set up limits.

**EXTREMELY VERSATILE**
Can be used with standard height stand or special fixture for manual inspection, for automatic in-process, or post process inspection and segregation. Standard air-electronic adapter kit permits use for air gaging.

**COMPACT**
Only 8½" wide, 9¼" high, 14¼" long.

*For further particulars, see your RCA Representative or write to:*

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**RADIO CORPORATION OF AMERICA**
INDUSTRIAL AND AUTOMATION DIVISION
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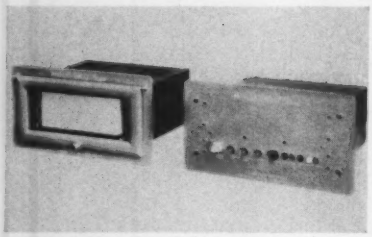
*Circle 703 on Page 19*


an electric motor drive. The ammeter in the control visually measures the conveyor line pull by monitoring the current drawn by the drive motor or motors. The safety shut-off point on the ammeter is determined by operating a properly lubricated conveyor under normal load, and setting the limit pointer slightly above the normal reading. If the line pull exceeds this limit, the conveyor motor is shut off instantly. The control is self-compensating for motor starting surges. **Conveyor Div., American Mono-Rail Co.**, 4th & Franklin Sts., Tipp City, Ohio.

*Circle 459 on Page 19*

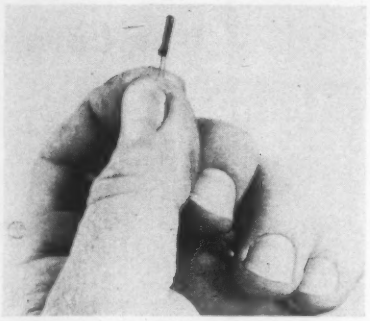


## Recorder

Instrument is suitable for monitoring digitized or sequential data or special forms of analog-type data. It operates on a change in the incoming signal in either an analog or digital channel. An electrosensitive record is produced by self-contained transistorized sensing circuits powered from an internal rechargeable nickel-cadmium battery. The time at which the record is taken is indicated electrically on the chart.

Unit has 6 *Off-On* channels and 1 analog (digitized) channel. It operates at standard chart speeds with a starting time of 19 m sec to reach 63 per cent of operating speed. Frequency response is 0-600 cps for the analog channel and 0-200 cps on the *Off-On* channels. Accuracy is ±2.5 per cent for the analog channel, marked with 50 digits peak-to-peak at maximum deflection. Record loading is through the front panel, which eliminates removing the recorder or disturbing adjacent equipment. **Hathaway Instrument Div., Hamilton Watch Co.**, 5800 E. Jewell Ave., Denver 22, Colo.

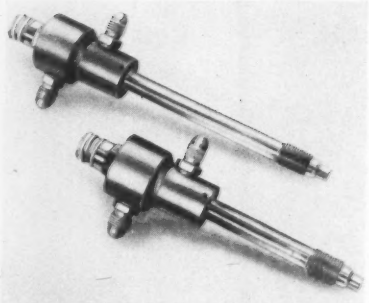
*Circle 460 on Page 19*



## Germanium Photodiode

Unit is applicable for punched-card or tape reading in continuous-process monitoring, and in either computing or control systems. A small diameter integral lens concentrates light on the sensitive portion of the junction area, eliminating external light-focusing devices. It can be used in either the visible or infrared portions of the spectrum. Sensitivity of Model TP-55 is approximately 30 ma/lumen at an ambient temperature of 20 C. Dark current is less than 5 microamperes. The sensitive surface is less than approximately 1 $mm^2$. **Nucleonic Products Inc.**, 1601 Grande Vista Ave., Los Angeles 23, Calif.

*Circle 461 on Page 19*

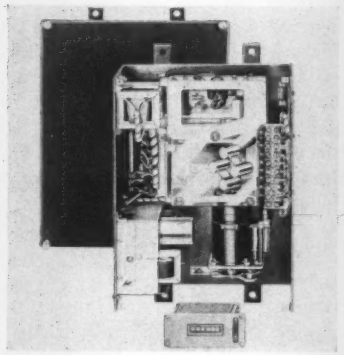


## Pressure Transducers

Suitable for use in thermoplastic extrusion process instrumentation, pressure transducers can sense pressure fluctuations in the melt and initiate corrective information to maintain constant pressure and constant flow of the molten material. Model PT 58 has a repeatability of 0.1 per cent and a maximum diaphragm operating temperature of 750 F. Feature of the transducers is a water cooling jacket that pro-

tects the strain gage sensing element from the high temperature environment at the diaphragm. The cooled portion of the transducers is far enough away from the diaphragm to insure that the melt will not solidify on the pressure sensing surface. Units are available in the pressure ranges of from 0-1000 to 0-10,000 psi. **Dynamic Instrument Co. Inc.**, 42 Carleton St., Cambridge 42, Mass.

*Circle 462 on Page 19*



## Integrator/Computer

Square-root instrument is applicable in flow measuring systems which require a digital readout of totalized flow. Model C3A/1 consists of two separately housed assemblies: A computer package, and an electromagnetic six-digit indicator. When installed in parallel with a company flow indicator, recorder, or controller, it will operate from a common zero to 0.5 v ac signal and has no effect on the control loop.

In operation, the process flow signal is compared in an error amplifier with a feedback signal of corresponding magnitude. The output of the servo amplifier drives a variable-speed servomotor which operates a magnetic switch providing pulses to the magnetic counter. The square root is extracted by interposing a flyball governor in the feedback loop from the servomotor to the servo amplifier. The flyball governor, rotated by the servomotor, exerts a force proportional to the *square* of its speed. This force positions the core of a differential transformer, providing a feedback signal to the servo amplifier input. The signal is compared with the process signal which is proportional

REEVES® Vari-Speed Motodrives
mean versatility in variable speed
101 different standard assemblies
18 different standard right angle assemblies
9 different standard inverted vertical assemblies
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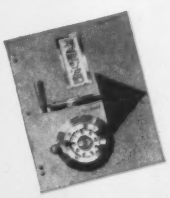
There's a *standard* REEVES Motodrive for virtually *any* installation. Rugged, compact variable speed . . . ¼ to 20 hp. . . . 1.7 to 4660 rpm. . . . 2:1 thru 10:1 speed variation. Other units up to 40 hp. There's space-saving versatility, too. Choose either "C" flow style (illustrated) or "Z" flow (motor on opposite side of case from output shaft).

**Extra precision** . . . a complete line of controls, ie. AIRtrol (a pneumatic positioner), electric remote control, mechanical controls, magnetic brakes and tachometers. **Extra versatility** . . . to meet specific needs, REEVES offers a full array of modifications, ie. special motors, shaft extensions and scoop mountings for foot-mounted motors.



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R MASTER REEVES

*Circle 704 on Page 19*

to the square of the flow rate. The servo amplifier forces the two squared signals to be equal. Since the output signal is taken from the motor speed, it is linear with respect to flow. **Swartwout Co.**, 18511 Euclid Ave., Cleveland 12, Ohio.

*Circle 463 on Page 19*

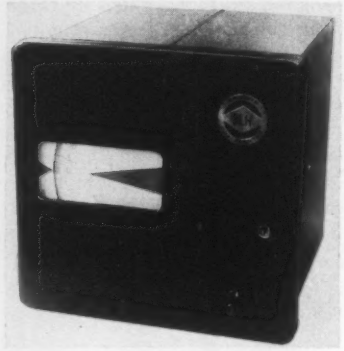
## Power Supply Control

Designed to serve as a power supply control for company's electromagnetic clutch/brake drives and clutch/sheave combinations, device is also suitable with other makes of low-current (under ½ amp) electromagnetic clutch and brake units. It can be used with almost any type of automatic switching for start-stop cycles, positioning, or jogging. The control converts to the required dc voltage (zero to 100 v) from incoming 115/230/460 or 575 ac current. It incorporates potentiometer selection of acceleration and deceleration rates, as well as torque limitation protection. Unit is available in either chassis mount or enclosed panel assemblies. **Cycledynamics Inc.**, 19025 W. Davison Ave., Detroit 23, Mich.

*Circle 464 on Page 19*

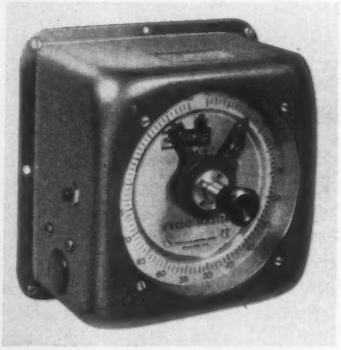
## Disc Indicator

Designed for use with strain gage transducers, instrument is applicable in weight and load measuring systems, pressure systems, and torque and horsepower measuring systems. Disc indicator is an automatic, null-blance type unit using a servo-driven slide wire to balance an internal bridge circuit. Accuracy is ±0.15 per cent of full



scale. It requires less than a square foot of panel area for mounting. Features are: A horizontal readout window and up to 500 engraved dial graduations. Indicator is furnished in thirteen different models. **Electronics & Instrumentation Div., Baldwin-Lima-Hamilton Corp.**, 42 Fourth Ave., Waltham 54, Mass.

*Circle 465 on Page 19*



## Recycling Controller

Applicable for the control of motors, valves, pumps, relays, and signals; electrically operated preset counter can instantly and automatically recycle an integral control circuit. It is suitable for continuous as well as intermittent counting operations. Other uses include: Liquid metering control, interval indication in high production count, and control of container filling.

Unit can be preset to any cycle from 1 to 100 counts. Electric impulses at speeds up to 1000 counts per minute can be obtained. If it is necessary at any time to interrupt the counting process and start over from the beginning of the cycle, the counter can be zeroed manually by holding the reset button and turning the dial knob. The

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**. . with an A-F ENGINEERED CONVEYING SYSTEM**

Take a good look at *your* warehouse! Chances are, it offers possibilities for *big savings* by replacing intermittent, old-fashioned handling methods with an efficient, *continuous-flow* A-F *Engineered* Conveying System.

With such an A-F Conveying System, items can be collected from various locations, identified and routed to the proper storage conveying lines—then selected orders are dispatched to designated shipping docks—*all automatically!*

Whatever your requirements, A-F can *engineer* the *proper* type of conveying system for both your *plant* and your *warehouse*. Write us—without obligation—today.

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Wheel, Trolley, Roller, Belt
Metal Cleaning and Processing Machines

**THE ALVEY-FERGUSON CO., 174 Disney St., CINCINNATI 9, OHIO**

*Circle 705 on Page 19*

unit operates directly on a 115 v, 60 cycle current. The basic control circuit consists of a single pole, double throw relay switch rated to handle a noninductive load of 10 amp at 115 v ac. **Counter & Control Corp.**, 4503 W. Brown Deer Rd., Milwaukee 18, Wis.

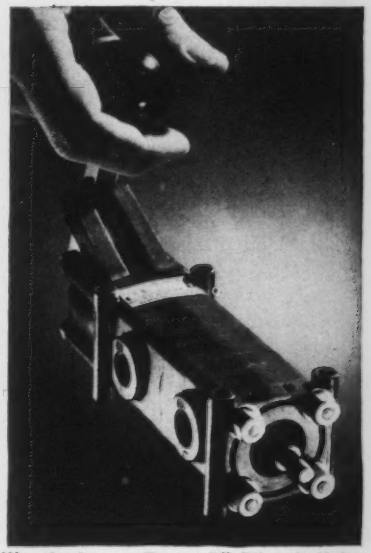
*Circle 466 on Page 19*

## Temperature Transmitter

Unit is capable of converting low level dc electrical signals to proportional 1 to 5 ma dc signals for transmission to distant measurement and control systems. It is applicable to thermocouples, resistance bulbs, strain gages, pH amplifiers, tachometer generators, or any other sensing element producing a dc signal. Model E710 is a four arm Wheatstone Bridge circuit in which input is compared with a measured portion of the output signal. Any unbalance between the two signals is detected by a sensitive electromechanical balance and amplified by an oscillator amplifier as the output signal. A hairspring loading the balance beam is the null adjustment. To provide thermocouple break protection, the hairspring can be set with a screwdriver to give either a maximum or minimum output signal when input is interrupted. A disconnect switch automatically shuts off power to the instrument before the amplifier is removed from the case. The transmitting potentiometer is available with either thermocouples or resistance bulbs for straight or differential temperature measurements. **Manning, Maxwell, & Moore**, Stratford, Conn.

*Circle 467 on Page 19*


# Typical Control Functions solved by AIR CIRCUITRY



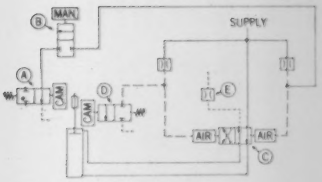
**Westinghouse Type "D" Pilotair Valve**

Another of Westinghouse Air Brake's many AIR CIRCUITRY components, the "D" PILOTAIR® Valve is a spool-type directional valve that can be operated by a lever, button, cam, solenoid, air pilot, pedal or treadle. Valves available in two, three, and four-way operation, two and three position, open neutral, lap neutral and vented neutral. Port sizes are ¼" and ½" ips. Operators may be on either or both ends. Max. operating pressure: 250 psi.

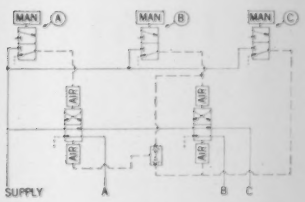
**DESIGN FEATURES.** A new design of seal and segment construction gives the "D" PILOTAIR® Valve increased capacity and requires a minimum of maintenance. By rotating operators, their mounting brackets and any of their ports in 90° steps, over one-hundred thousand combinations may be obtained. They operate in any position with air, gas, water and most oils. The "D" PILOTAIR® Valve can satisfy any of your directional valve needs. For more information, ask for catalogue A4-75.01.

### What is AIR CIRCUITRY?

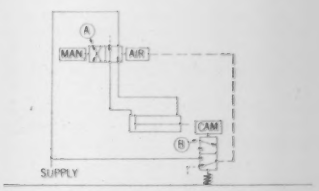
This is the Westinghouse term for application of pneumatic control systems to industrial production operations. Safe, economical, precise Air Circuitry is now being used to solve the most rigorous and complex control problems in industry. Westinghouse Air Brake has pioneered the application and development of air control for more than 80 years. Today our engineers can design an air circuit which will boost production and cut costs.




**1. AUTOMATIC CYCLING**—Supply air flows to the cylinder to extend the cylinder rod and actuate cam operated valve "A." By operating valve "B" air is bled from the right-hand air pilot of valve "C" to operate this device and retract the cylinder rod. This actuates valve "D" and reverses the process. Cycling time may be changed by regulating the FLOREG® valve "E." The stroke is set by moving the cams on the cylinder rod.




**2. STATION TRANSFER**—Any of the three stations may capture supply air for the station by operating its respective valve. This may be expanded to any number of stations.




**3. AUTOMATIC RESET**—To reset the operating valve "A" after completion of an operation. Moving the manual operator admits supply air to the cylinder to extend its rod. At the end of the cylinder rod stroke cam operator valve "B" is actuated to connect supply air to the air pilot operator of valve "A." This returns this valve to its original position. Supply air is then connected to the cylinder to retract the cylinder rod. The circuit is now ready for recycling.

*See the Yellow Pages under Cylinders for the Name of Your Local Distributor*

**WESTINGHOUSE AIR BRAKE COMPANY**
INDUSTRIAL PRODUCTS DIVISION, WILMERDING, PENNSYLVANIA

*Circle 706 on Page 19*

# MINIATURE MANIFOLDS

for

## Multi-Purpose CONTROL

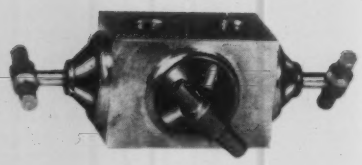


*Photo ½ actual size*

*PACKLESS*

## "DEMI"
## M2 SERIES

All models of the standard Dahl "Demi" M2 series of three-valve manifolds are readily adaptable to clean liquid, gas and vapor applications. The size of these manifolds makes them especially suitable for pilot plant, aircraft and marine applications, flow control and automation. They are miniature in size, yet their patented form for bubble-tight shutoff makes them comparable to much larger valves in performance.
These manifolds consist of two block valves and one bypass valve in place of 3 separate valves . . . they eliminate two tees, four nipples and eight threaded connections. Models of the "Demi" M2 series come in a variety of barstock materials and may be ordered with special features such as: bolted bonnets, swaged-in TEFLON seats, toggle actuators, etc.

| | |
|---|---|
| **PRESSURE RATING**<br>Metal Body & Diaphragm<br>Neoprene Diaphragm | <br>750 psi at 450°F<br>100 psi at 180°F |
| **MAXIMUM Cv** | 0.4 |
| **CONNECTIONS** | 1/16", 1/8", 1/4" N.P.T. |

*Send for the "DEMI" Catalog D-1 and other technical data on Dahl pneumatic and hydraulic valves.*

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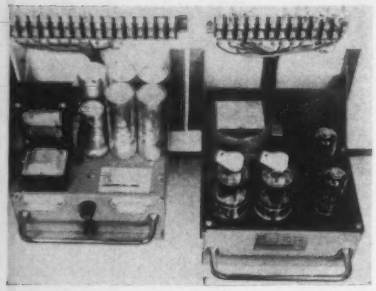
DAHL
COMPANY, INC.

86 TUPELO STREET, BRISTOL, RHODE ISLAND

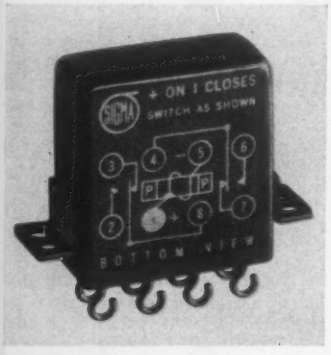
*Circle 707 on Page 19*

## Servomotor Control

Combination electronic servo amplifier and power supply is capable of controlling a wide range of ac servomotors with mechanical power outputs up to 10 w. The amplifier accepts low level ac signals from transducers. The output power from the amplifier is available at various impedance levels because of a combined matching and isolation transformer. The power supply converts an ac input voltage to the filament and dc voltages needed to operate the electronic amplifier. It can also provide excitation voltage for external signal displacement transducers when they are used as a signal source. Pilot lights on the power supply indicate the existence of ac voltage and dc output voltage. **Electronics Div., Seneca Falls Machine Co.**, 19 Fyfe Bldg., Seneca Falls, N. Y.

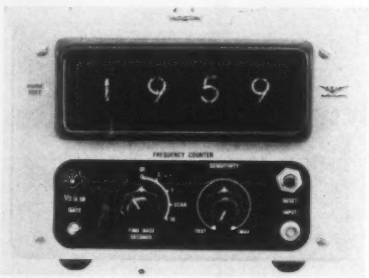
*Circle 468 on Page 19*




## Subminiature Relay

Subminiature, polarized relay features magnetic latching. In operation, the relay armature is transferred from one fixed position to the other by a coil signal of the correct polarity and magnitude, and is held in place by a permanent magnet. A signal of the opposite polarity is required to return the armature to its original position. The unit, designated Series 32, can withstand 30 g vibration to 5000 cycles. Contact rating is 2 amp for silver contacts, 0.5 amp for gold alloy. Unit is available with either single or dual coils; with an operating sensitivity of 50 milliwatts for the single coil and 100 milliwatts for each of the dual coils. Operating temperature range is from −65 C to +125 C. Some of the mounting styles include: Plain can, stud, flange, or plate mounting with *J* hook solder terminals, 8-pin plug, 10-pin plug, or 3-inch long connecting wires. **Sigma Instruments Inc.**, 170 Pearl St., So. Braintree 85, Mass.

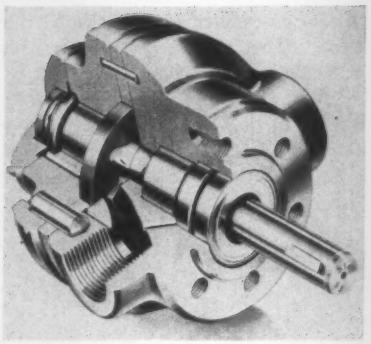
*Circle 469 on Page 19*




## Tachometer-Counter

Instrument can be used as a tachometer, a flow rate indicator, or an indicator for pressure, temperature, acceleration, velocity, or force. Model 100T features beam magnetron switching tubes in the counting unit and in-line indicator tubes as the readout. The power supply uses silicon rectifiers. Two independent, bridge - rectified dc sources are used to provide higher voltages with a minimum of power dissipation. Time base of the counter consists of transistors mounted on a pluggable printed-circuit card. The input amplifier, squaring amplifier, gate and beam-switching tube drivers are also located on a pluggable printed - circuit card. These cards are located on either side of the unit, away from the central heat-producing components to minimize heating of the transistors. **Erie Pacific Div., Erie Resistor Corp.**, 644 W. 12th St., Erie 6, Pa.

*Circle 470 on Page 19*



## Pump

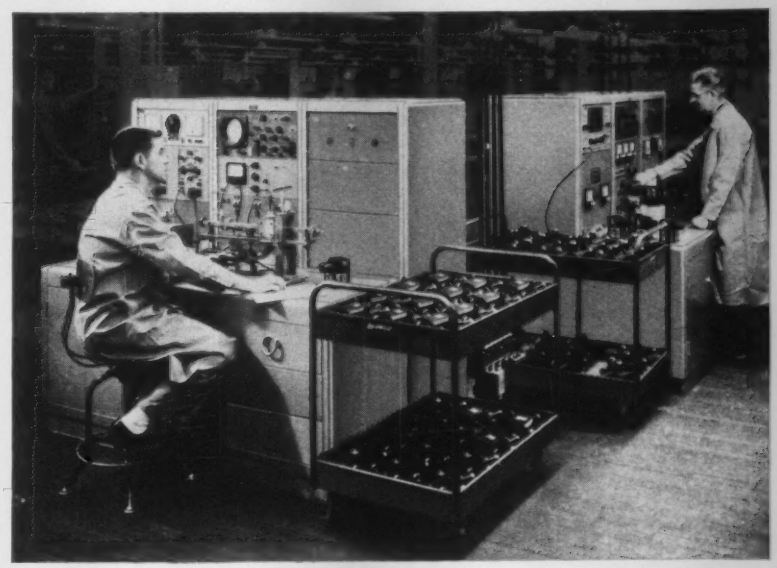
Pump is suitable for use with fire-resistant fluids such as encountered in die casting, welding, and forging operations. The pump, designated Series 800, is available in 3, 5, 8, and 12 gpm sizes in QDH-830 single pumps; 20, 30, and 40 gpm sizes in OG-860 single pumps; and any combination of 3, 5, 8, or 12 gpm in QGH-H-830 double pumps. All pumps in the line are dimensionally interchangeable with regular oil-hydraulic units of comparable capacities. **Double A Products Co., Subsidiary, Brown & Sharpe Mfg. Co.,** Manchester, Mich.

*Circle 471 on Page 19*

## Indicator-Recorder

Servo instrument can indicate and record forces, fluid flow, weights, or rpm's which can be converted into ac or dc mv signals. Feature of Model 243 is a synchronized chart drive which permits the permanent recording of transducer outputs with digital readout. Digital readout accuracy is 1/10 of


# EMCOR®* CABINETS ENCLOSE "NERVE CENTERS" FOR AUTOMATIC PRODUCTION



EMCOR Cabinets house equipment for testing of microwave components at the TAPCO GROUP, Division of Thompson Ramo Wooldridge Inc., Cleveland, Ohio.

EMCOR Cabinets house "SMART" — The Sequential Mechanism for Automatic Recording and Testing designed and built by Texas Instruments Incorporated, Dallas, Texas. The unit evaluates transistors automatically and economically with consistent accuracy.

Standard EMCOR Cabinets prove their versatility and flexibility daily in industrial applications. Electronic computers, data loggers, readout gear, testing and research equipment are housed in EMCOR units in hundreds of key installations. Advanced EMCOR Engineering "know-how" in metal cabinetry is keeping pace with automatic production line operations. Costly custom housing design time is eliminated. The flexible, versatile and structural capabilities of over 600 basic frames in the EMCOR MODULAR ENCLOSURE SYSTEM solve the daily packaging problems of industrial design engineers. Let EMCOR Engineering "know-how" work for you. Write for full information today.

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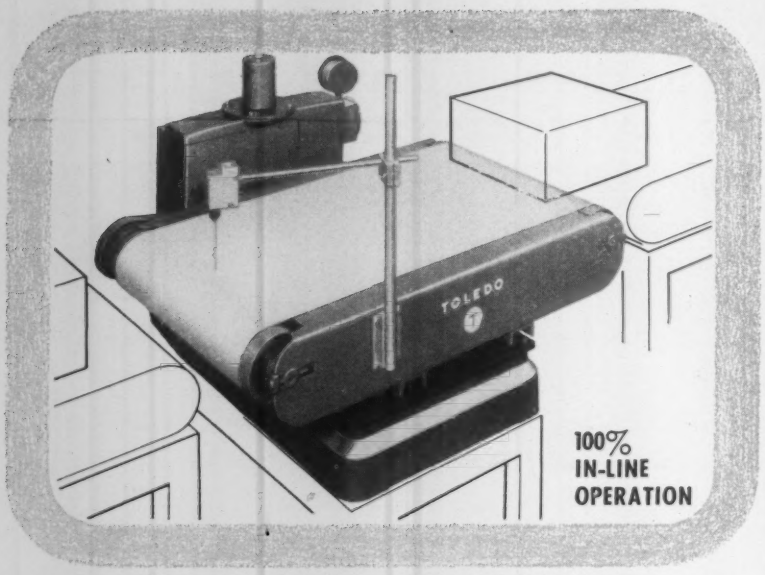
*Originators of the Modular Enclosure System*

**ELGIN METALFORMERS CORP.**

630 CONGDON, DEPT. 1231 • ELGIN, ILLINOIS

*Registered Trademark of Elgin Metalformers Corporation

*Circle 708 on Page 19*




FAST, AUTOMATIC, IN-MOTION

CHECKWEIGHING

WITH NEW TOLEDOS

**MODEL 9460**
Items 50 to 200 Lbs.,
to 40 per min.

**MODEL 9463**
Items 5 to 50 Lbs.,
to 40 per min.

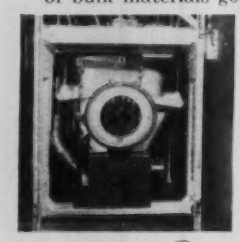
Get 100% in-line checkweighing with these new Toledos! Checkweigh bags, cartons, packages, parts and pieces automatically. You'll save time, labor and material . . . keep weights consistent . . . build customer goodwill.

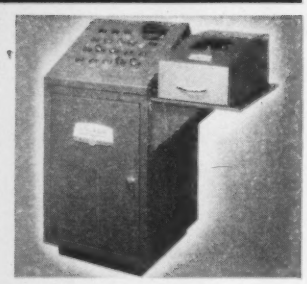
Designed with continuous-running motorized conveyor on the weigh section, these Checkweighers fit readily into conveyor lines . . . are accurate to one part in 3,000. Available with remote zone indication stations for continuous visual check, magnetic counters to accumulate operating data, and other advanced Toledo features.

Now is the time to check into Toledo Checkweighers for your operations! Send for Bulletin 2968. TOLEDO SCALE, Division of Toledo Scale Corporation, Toledo 12, Ohio.

**Toledo Automatic Bulk Weighing . . . net weight listing and totaling**

Get accurate net weight listing and totaling of bulk materials going into truck or carload shipments. Weighing is automatic. You save time, control costs and reduce claims. The Toledo control console which interlocks all elements of the system, may be remotely located for operating convenience. Ask for Bulletin 2490.





SERVICE Factory-Trained 240 Cities

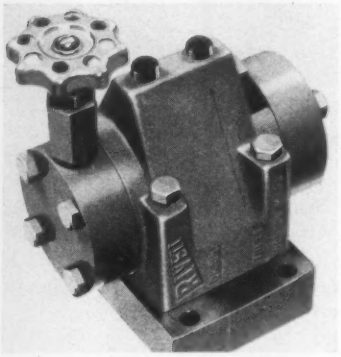
TOLEDO®

*Headquarters for Weighing Systems*

Circle 709 on Page 19

1 per cent; chart accuracy is ±1 per cent. The panel-mounted case is 6 inches wide by 11⅛ inch high by 12 inches deep. **Gilmore Industries Inc.**, 13015 Woodland Ave., Cleveland 20, Ohio.

Circle 472 on Page 19



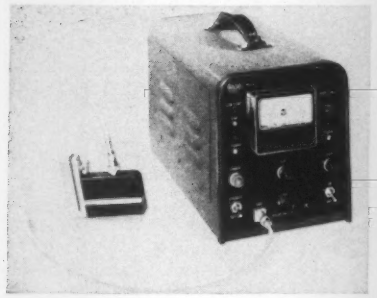
## Hydraulic Valve

Line of pressure controlled valves is applicable in a hydraulic circuit for relief, sequence, unloading, reducing, and counterbalance operations. Valve is rated for 3000 psi and full pressure rating can be obtained in all units at the point of valve opening. Units meet J.I.C. requirements; are available in pipe and sub-plate mountings; with and without check, and direct operated or pilot operated. The regulating lands of the spool are fluted to provide smoothness of opening and closing, and to minimize the hydraulic shock. Valve is available in three sizes. With flow rating at 15 fps, one nominal rating is 9 gpm with ½-inch maximum pipe size; the second rating is 27 gpm with 1-inch maximum pipe size; and third nominal rating is 55 gpm with 1½-inch maximum pipe size. **Rivett Inc.**, Brighton 35, Boston, Mass.

Circle 473 on Page 19

## Signalling Comparator

Instrument can be used for small lot inspection or spot checking of production runs, or for automatic in-process or post-process gaging and segregation. An air-electronic kit can be furnished making the unit adaptable for air gaging. Nine



different gage heads are available permitting direct readings ranging from 0.000050-inch per dimension to 0.001-inch per dimension. Full scale deflection of the meter is a direct 20 v change in the gage output.

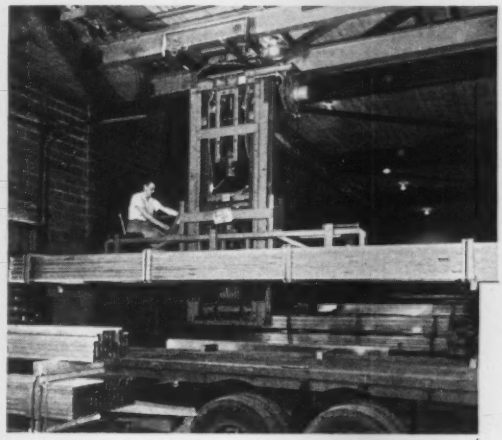
Set-up can be made by using any single part of known dimensions. The gage head is first adjusted by means of the vernier until the reference part size is indicated on the meter. Then with the set-up switch in proper position, the desired limits are dialed in and the coarse and fine signal controls are adjusted. Normally open and closed contacts operated by the limit signals are located at the back of the panel for operating audible signals, electric counters, and reject gates. **Industrial & Automation Div., Radio Corp. of America,** 12605 Arnold Ave., Detroit, Mich.

*Circle 474 on Page 19*

## Air Clutch

Self-adjusting, disc type air clutch can be used on all company open-back inclinable presses. It operates on controlled air pressure and engages a full 360 degrees of friction surface. Feature of the clutch is a dual air solenoid valve which is regulated by two interlocking control circuits and actuates the clutch through air intakes located in the flywheel. When the clutch is engaged, total contact of the driving disc and friction disc is established with a minimum amount of movement. The flywheel mounting reduces the mass to be put into motion when the press is cycled. Lack of any overlapping drag in the brake assures fast action in engaging and disengaging at any speed. **Federal Press Co.,** Elkhart, Ind.

*Circle 475 on Page 19*

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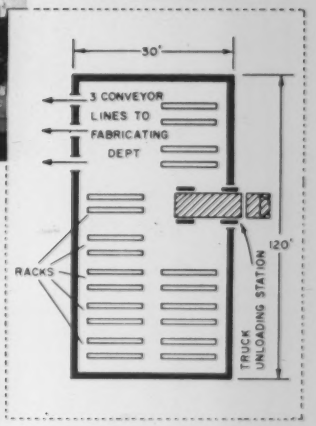



...and TRAK-RAK *handle complete warehousing operation*

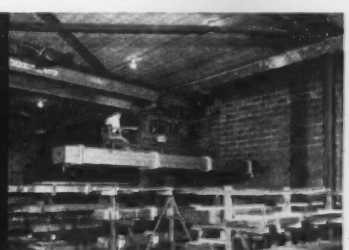
**UNLOADS TRUCKS, STORES MATERIAL IN 1 OPERATION**

When the Per-Fit Products Corp., Indianapolis manufacturer of aluminum windows installed a Chicago Tramrail TRAK-RAK unit in its warehouse, it gained 4 big advantages:

1. **Increased the capacity of existing storage area.**
2. **Reduced handling costs by permitting 1 man to handle the entire warehouse.**
3. **Kept production lines supplied with on-time material deliveries.**
4. **Handled high grade aluminum extrusions without damage.**

The TRAK-RAK unit installed at Per-Fit consists of a 1 Ton capacity underrunning crane from which is suspended an electrically operated rotating telescoping column which is fitted with a three-fork carriage. All operations of the TRAK-RAK unit are controlled by the operator, who rides with the carriage. The unit serves a series of self-standing racks equipped with arms which receive the bundled material. Because the TRAK-RAK column requires minimum operating space, the aisles between racks are very narrow.

Trucks delivering material are unloaded (top picture) by the unit, which moves over the tops of the racks (below) to the proper rack and deposits its load in 1 operation. When a particular bundle is required by production, the operator moves to the rack, picks up the bundle, and, moving overhead, travels to the conveyor lines (drawing) and sets the bundle down on the designated conveyor line.




TRAK-RAK Systems of vertical storage and handling are saving time and money in warehouses and production plants of all types. *For complete details on how TRAK-RAK can help solve your problems, write:*

**CHICAGO TRAMRAIL CORPORATION**

1306 S. Kostner Avenue • Chicago 23, Illinois

*Circle 710 on Page 19*

AUTOMATION

# catalogs and literature

Latest automation information. For copies use card on page 19.

## Control Components

*Ketay Dept., Norden Div., United Aircraft Corp., Commack, L. I., N. Y.*—170 *page catalog*—Data are given on complete line of synchros, servomotors, servo amplifiers, resolvers, rate gyros, and potentiometers. Illustrations of the different models are shown and typical characteristics are listed. Numerous performance charts and outline drawings are also included.

**Circle 476 on Page 19**

## Spindles

*Bryant Chucking Grinder Co., Springfield, Vt.*,—14 *page booklet*—High-frequency spindles, motorized spindles, and built-to-order induction motors are described in Bulletin S-1. Dimensional drawings are given and charts show power characteristics. Mounting methods and spindle oil mist lubrication system are also explained.

**Circle 477 on Page 19**

## Ultrasonic Cleaning

*Circo Ultrasonic Corp., 51 Terminal Ave., Clark, N. J.*—12 *page booklet*—Basic principles of ultrasonics are discussed in booklet, entitled "Tips on Ultrasonic Cleaning." Generating equipment and transducers required for ultrasonic cleaning are described and various applications are noted. Also included are a list of questions and answers most frequently asked about ultrasonics.

**Circle 478 on Page 19**

## Magnetic Starters

*Furnas Electric Co., 1128 McKee St., Batavia, Ill.*—16 *page booklet*—Line of magnetic starters, through 15 hp 440-550v, is described in Catalog 14-B1. Principle of the thermal relay operation is explained, and wiring diagrams are given. Maintenance features are covered and notes are included on switch modification kits.

**Circle 479 on Page 19**

## Vibratory Feeders

*Eriez Mfg. Co., Erie, Pa.*—6 *page pamphlet*—Line of electro-permanent magnetic vibratory feeders for precision feeding, spreading, sorting, cooling, sifting and mixing is described in Bulletin VB-10-1. Illustrations show the different units for light feeding applications and for applications for handling up to 10 tons (dry sand) per hour. Charts list features and specifications.

**Circle 480 on Page 19**

## Gear & Fluid Drives

*Link-Belt Co., Prudential Plaza, Chicago 1, Ill.*—48 *page catalog*—Line of gear motors, motor gears, and fluid drives in ratios from 6.2:1 through 985:1 is described in Book 2747. Suggestions are given for making the proper selection of a unit and charts with load classes, drive sizes, and overhung load ratings are listed. Sketches show mounting styles and notes are also given on accessories such as couplings, backstops, and slide rails.

**Circle 481 on Page 19**

## Box Making Machine

*Colt Packaging Machinery Co., 51 Washington Ave., Cranston 7, R. I.*—8 *page bulletin*—Machine described produces corrugated boxes and shipping containers in varying sizes at the rate of 300-500 boxes per hour. It is explained how the machine can be adjusted to the different packaging requirements, making containers of various sizes to meet daily needs. A dimensional change can be made in approximately 1½ minutes.

**Circle 482 on Page 19**

## Cam-Operated Indexing Units

*Standard Tool & Mfg. Co., 237 Laurel Ave., Kearney, N. J.*—26 *page catalog*—Three cam-operated indexing units are outlined—Models ST-A9B, ST-A9C, and ST-A9D. Dimensional drawings of the units and tooling and dial plates are given. Tables list indexing positions and cams and load ratings.

**Circle 483 on Page 19**

## Equipment Control Connectors

*Electrical Products Div., Joy Mfg. Co., 1201 Macklind Ave., St. Louis 10, Mo.*—12 *page booklet*—Equipment control connectors designed for applications up to 600v are described in Bulletin 372. Illustrations show the three basic styles—oval, round, and dual round available in 2 to 12 poles. Construction features, outline drawings, and specifications are noted.

**Circle 484 on Page 19**

## Variable Transformers

*Superior Electric Co., Dept. 126, 83 Laurel St., Bristol, Conn.*—8 *page bulletin*—Open, enclosed, fused, card-plug, and enclosed terminal type variable transformers in a range between 1 kva and 3 kva are described in Bulletin P559. Units in the line are rated up to 12.5 amp constant current rating and up to 18.0 amp constant impedance rating. Outline dimensions of the different styles are given and a cutaway photo shows design features.

**Circle 485 on Page 19**

## Modular Electronic Assemblies

*Industrial Tube Div., Raytheon Co., Dept. 2528, 55 Chapel St., Newton 58, Mass.*—6 *page pamphlet*—A welded assembly technique for packaging electronic components suitable for use in data processing equipment and computers is described. The elements in the welding construction are explained, as is the testing procedure for these assemblies.

**Circle 486 on Page 19**

## Air Motors

*Hannifin Co., Dept. 142, 501 S. Wolf Rd., Des Plaines, Ill.*—8 *page bulletin*—Line of new air motors is described in Bulletin 215. The basic motor is a combination cylinder and solenoid actuated air control valve with built-in speed controls. Schematic drawings help explain the operation of the valve. Specifications and dimensions are given for the five bore sizes (ranging from 1¼ to 4½-inch) in each of the four mounting styles.

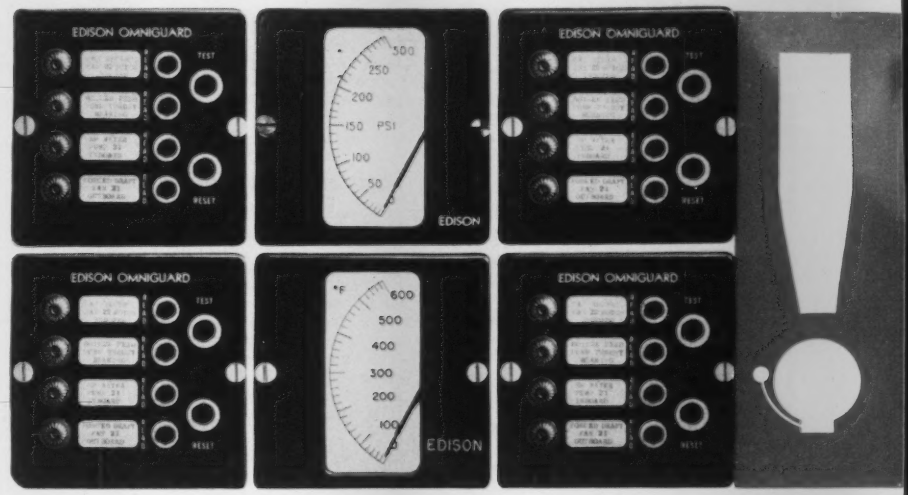
**Circle 487 on Page 19**

## Adjustable Speed Equipment

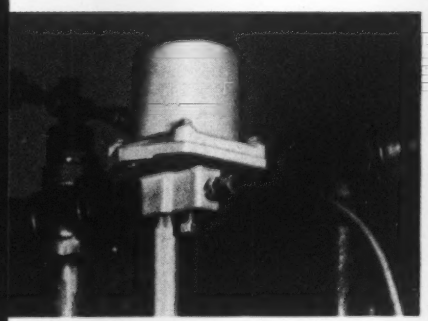
*General Electric Co., Schenectady 5, N. Y.*—8 *page bulletin*—Adjustable-speed drive equipment for extruders is described in Bulletin GEA-6909. This includes data on dc motors, Amplistat speed variators, and dc generators. Illustrations show speed variators and custom engineered systems.

**Circle 488 on Page 19**

# GUARD ALL CRITICAL PRESSURES AND TEMPERATURES WITH THOMAS A. EDISON LOW-COST, OMNIGUARD WARNING SYSTEM




Here is a versatile, highly-reliable continuous warning and monitoring system. By simply pushing a button on this panel you obtain a reading of *key pressure* and *temperature* points throughout your plant. In addition, this system provides instantaneous warning when pressure or temperature deviates from pre-set limits.

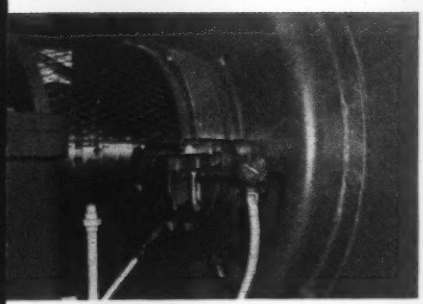


*Compact, reliable Resistance Pressure Detector transmits changes in pressure to central control panel.*

## PRESSURE

With the Edison Omniguard system you can monitor gas, fluid or vapor pressure. Heart of the system is a rugged, accurate, pressure detector which converts pressure directly to electrical resistance—requires no millivolt conversion—no amplifier. For pressures under 60 PSI a precision capsule is the sensing element. From 60 to 3000 PSI special burdon tube elements are used.

When pressure changes, resistance varies and this deviation is transmitted to the control panel. Units operate over ambient temperatures of 32° to 150°F. Control panels are available with a wide variety of scales and are equipped with both normally open and normally closed alarm contacts to operate any type of auxiliary device or to automatically shut down machinery or process.



*Rugged, accurate Resistance Temperature Detector guards against overheating of this motor bearing.*

## TEMPERATURE

Edison Omniguard also provides reliable protection from overheating. You can monitor the temperature of bearings, gases and liquids in critical equipments or processes. Reliable Edison Resistance Temperature Detectors have no moving parts and give instantaneous warning when limits are exceeded. Unlike other systems which only scan, Omniguard is continuously monitoring. You can obtain exact readings of temperatures in all parts of your plant from one central control panel.

For greater flexibility and reliability each detector circuit is completely independent. If one circuit is damaged, all other circuits remain "on guard." When changes or additions are required they can be accomplished quickly and easily.

**Thomas A. Edison Industries**
**INSTRUMENT DIVISION**
86 LAKESIDE AVENUE, WEST ORANGE, N. J.

McGRAW EDISON

Circle 711 on Page 19

## Air-Cooled Compressors

*Ingersoll-Rand Co., 11 Broadway, New York, N. Y.—16 page booklet*—Suggestions are contained in Bulletin 1548 on how to select small "packaged" air-cooled compressors (½ through 20 hp) for either automotive or industrial applications. Various charts list the cubic feet of air per minute required to operate pneumatic equipment, average and continuous air supply tables, and volumes of compressed air required to develop power to overcome indicated loads. Data are also given on compressor oils, pipe sizes, and wire sizes for electrical service.

**Circle 489 on Page 19**

## Preform Soldering

*Alloys Unlimited Inc., 21-01 43rd Ave., Long Island City 1, N. Y.—8 page bulletin*—Data on solder preforms and their uses in automatic production processes are given in booklet entitled "A Guide to Preform Soldering." Notes are included on the alloys from which the solders are made, alloy selection, and metals characteristics. Charts list temperature conversion, physical properties and melting points of tin-lead solders, commercial silver solders, and indium base solders.

**Circle 490 on Page 19**

## Lubrication Systems

*Lincoln Engineering Co., 4010 Goodfellow Blvd., St. Louis 20, Mo.—24 page catalog*—Automatic power lubrication systems for trucks, trailers, material handling equipment, and industrial machinery are outlined in Catalog 50. Data are given on three types of lubrication—air-operated, vacuum-operated, and manually-operated. Various applications and methods of operation are explained and component parts and accessories are listed.

**Circle 491 on Page 19**

## Surface Processing Machines

*Ransohoff Co., Hamilton, Ohio—40 page catalog*—Data are given on equipment for the surface treatment of metals (cleaning, washing, rinsing, drying, and spraying, flow and dip coating). Equipment includes drum type washing machines, conveyor type machines, combination drum and conveyor machines, agitated tank type machines, and barrel finishing machines. Notes are also given on custom-engineered finishing systems, along with flow diagrams of in-plant installations.

**Circle 492 on Page 19**

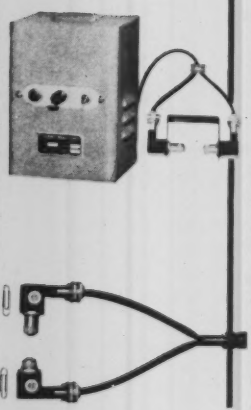
## Equipment Replacement Guide

*Jones & Lamson Machine Co., Springfield, Vt.—12 page booklet*—Booklet entitled "Avoidable Costs" Replacement Formula is a guide for the analysis of capital equipment replacement problems. It discusses a method for appraising the productivity of machine tools and other capital equipment. Three commonly used replacement formulas are given and compared with the new formula. Other points covered include rate of return approach and payoff period approach. Tables list projection of wage and material cost factors and projection of replacement cost factors for metalworking machinery.

**Circle 493 on Page 19**


# POST DECITRON ELECTRONIC PRODUCTS

### Photoelectronic Controls



**Model K-1 with Miniature Photohead**

This is a general purpose photoelectric control whereby the interruption of a light beam in the photohead closes a relay which can be used to activate an external circuit.

**Model K-3**

The K-3 control differs from the K-1 in that the output relay will not energize for each interruption of the light beam, but only if interruptions cease. Can be used to detect "flow" stoppage.

**Model H-21-C**

The compact, long life, *miniature* photohead . . . ideal for mounting in limited space. May be furnished with alignment brackets to insure proper relation of light source and receiver.

Decitron

**ELECTRONIC PRODUCTS DIVISION**

Post Machinery Co. | 159 Elliott St., Beverly, Mass.

**Circle 712 on Page 19**


## Spiral Point Drilling

*Cincinnati Lathe & Tool Co., Cincinnati 9, Ohio—24 page handbook*—A sharpening machine which converts standard twist drills into precision tools and eliminates secondary operations such as center drilling or center punching is the subject of Catalog SP-165. Some of the points discussed in pointing out advantages of spiral point drills are hole location, hole size, roundness, and straightness. Drill life and thrust requirements are also covered.

**Circle 494 on Page 19**

## Cycle Controller

*Bristol Co., Waterbury 20, Conn.—12 page booklet*—Applications, such as batch process operations using an impulse-sequence time-cycle controller, are explained in Bulletin C311. The controller described can have as many as ten pilots for controlling the timing of as many variables. Photos point out the features of the instrument, and they are then summarized. Notes are also given on variations of the basic model.

**Circle 495 on Page 19**

## Tube & Pipe Fittings

*Flodar Corp., 16911 St. Clair Ave., Cleveland 10, Ohio—28 page catalog*—Hydraulic tube and pipe fittings in three styles—flare, self-flaring, and no-flare type—are described in Catalog 556. Dimensional drawings and specifications are given. Also included are instructions for assembling self-flowing fittings and a chart for selecting the proper thickness of tubing.

**Circle 496 on Page 19**

## Heat Exchanger

*Western Precipitation Corp.—1016 W. Ninth St., Los Angeles 15, Calif.—12 page booklet*—An indirect heat exchanger, designated Holo Flite, is the subject of Bulletin HF 103. It involves a screw conveyor with helical hollow flights through which the heat transfer agent is circulated and moves the material to be heated, cooled, or dried at a predetermined rate. Design features of the unit are explained and installation photos show applications for drying, cooling, and heating. Sketches show single, double, and triple vertical tier arrangements.

**Circle 497 on Page 19**

## System Simulation

*Servo Corp. of America, 111 New South Rd., Hicksville, L. I., N. Y.—6 page pamphlet*—Subject of Bulletin SDR-1 is a servo system simulator (designated SERVOLAB) which is a packaged assembly of electronic and electromechanical components for simulating systems such as found in process control, automatic machine tools, and materials handling. It is explained how, by using this system, a designer can proceed from an idea to the final prototype with a minimum of effort.

**Circle 498 on Page 19**

## Air Power Devices

*Bellows Co., Akron 9, Ohio—16 page booklet*—Controlled air power devices described in Bulletin ML-5 provide all the motions necessary to operate and control

machinery. Illustrations show various applications. Notes are also given on company's idea files which contain descriptions of the methods used to automate an operation, or a group of related operations.

**Circle 499 on Page 19**

## Automatic Test Equipment

*Electronics Div., Stromberg-Carlson, 1400 N. Goodman St., Rochester 3, N. Y.—24 page handbook*—Automatic test equipment, designated SCATE, is the subject of Bulletin 307. The equipment is a preprogrammed automatic test system using only solid-state devices in computer circuit modules. Operation of the equipment in checking out complex electronic systems is explained and features of the various components are pointed out. Block diagrams show various applications.

**Circle 500 on Page 19**

## Pneumatic Equipment

*Gast Mfg. Corp., P. O. Box 117, Benton Harbor, Mich.—12 page booklet*—Booklet APP-9 entitled "Application Ideas" discusses the various uses of air motors, air compressors, and vacuum pumps. Schematic diagrams show the pneumatic principle used to perform a wide range of functions on industrial machines, business, and laboratory equipment. The diagrams are accompanied by actual photographs of the model used.

**Circle 501 on Page 19**

## Water Instrumentation

*Industrial Div., Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, Pa.—28 page handbook*—Reprints containing questions and answers on instrumentation as applied to water and sewage treatment are included in Booklet D97-2. Reports are given on the instruments water and sewage plants use, how they are used, and how they automatically control the many variables in water and sewage treatment processes.

**Circle 502 on Page 19**

## Electromagnetic Clutches

*I-T-E Circuit Breaker Co., 1900 Hamilton St., Philadelphia 30, Pa.—20 page booklet*—Data are contained in Bulletin R-6304-1B on line of electromagnetic clutches in six series, with torque capacities from 1.8 through 13,000 lb-ft. Suggestions are given for selecting the proper clutch for applications on grinders, drill presses, boring mills, milling machines, lathes, and printing and packaging machinery. Dimensional drawings and charts listing operating characteristics are also included, as are notes on clutch accessories and components such as arc suppressor units, drive cups, and power packs to supply the required dc.

**Circle 503 on Page 19**

## Servo Components

*Vernitron Corp., 136 Church St., New York 7, N. Y.—collection of data sheets*—Data are given on line of servo components such as control synchros, resolvers, resolver sweep, and torque synchros. Outline dimensions are also included, as are notes on company facilities and personnel.

**Circle 504 on Page 19**

## Valves, Baffles, Traps

*Rochester Div., Consolidated Electrodynamics Corp., 1775 Mt. Read Blvd., Rochester 3, N. Y.—28 page catalog*—Data are given on line of high vacuum valves, baffles, and traps. Valves range in size from ¼ to 36 inches, include types such as globe, gate, quarter-swing, right-angle, and ball valves. Types of baffles described include water-cooled, freon-cooled, and liquid-nitrogen-cooled. Glass and copper-foil traps are also covered.

**Circle 505 on Page 19**

## Electronic Controls

*De-Tec-Tronic Corp., 2512 N. Halsted St., Chicago 14, Ill.—6 page pamphlet*—Automatic, electronic controls for steel and tinplate mills, can manufacturers, and metal decorators are outlined in Bulletin 859-D. Units described include electromagnetic controls such as double sheet detector, over and under gage sheet detector, and coil steel thickness gage; and photoelectric controls such as coil stock pinhole detectors, counter controls, and coil steel dull plate detector.

**Circle 506 on Page 19**

## Filters

*Eimco Corp., P. O. Box 300, Salt Lake City 4, Utah—8 page bulletin*—Filters which can be used in a variety of chemical and metallurgical processes for high solids recovery are described in Bulletin F-2052. Design features are explained, as is the washing efficiency of the frame filter. Detailed sketches show the complete filtration cycle including air flow, slurry flow, filtrate, and cake and washwater flow. Notes are also given on how the filters can be equipped with electric timing controls and auxiliaries for automatic operation on a multicycle basis.

**Circle 507 on Page 19**

## Thermocouples

*Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.—52 page catalog*—Data are contained in Catalog EN-S2 on line of thermocouples, thermocouple components, and accessories. Descriptions are given on standard assemblies in protecting tubes and wells for general applications, and specialized thermocouples and assemblies for industrial applications. Information is also included on line of bare and insulated thermocouple wires, replacement elements, ceramic insulators, metal and ceramic protecting tubes, wells, terminal heads, and extension leadwires.

**Circle 508 on Page 19**

## Hopper Feeder

*Clark Industries, P. O. Box 314, Delaware, Ohio—4 page pamphlet*—Two hopper type units for automatically power feeding cylindrical shaped stock into production machines are described. Parts from 1-inch to 21-ft lengths can be accommodated by the machines. Notes are given on supplementary devices which aid in the conveyance of parts to the machine or discharge of parts from the machine.

**Circle 509 on Page 19**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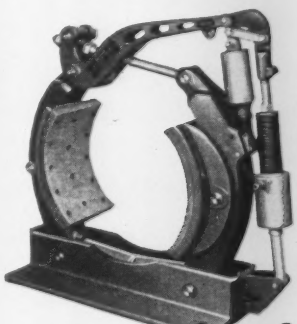

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**Circle 713 on Page 19**

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Circle 714 on Page 19

# AUTOMATION abstracts

## MAGNETIC TAPE RECORDERS FOR INDUSTRIAL CONTROL

By EDWARD G. WILDANGER
Mgr., Application Engineering
Ampex Corp.
Redwood City, Calif.

SOME of the features which made magnetic tape attractive in other fields have also stimulated interest among industrial users. Digital computers are being built in increasing quantities. These computers have voracious appetites for data. Furthermore, since operating time is fairly expensive, there is need for high-speed data transfer in and out of computers. The punched-card can, and is, used on computers. Punched tapes are also used to a limited extent. However, these media are considerably slower than magnetic tape. They are satisfactory only if transfer rates in the order of a few hundred characters per second can be tolerated. Computers used over the past several years can accept data at approximately 10,000 to 15,000 characters per second. Newer computers presently in the market operate satisfactorily at input rates of 45,000 to 60,000 characters per second. As always, there is a demand for faster and faster transfer rates.

Both research and computer designers have capitalized on some of the advantages to be offered by magnetic tape. Primary advantages are:

1. *Huge information capacity.* When used in computer systems, a single 10½-inch reel of magnetic tape can satisfactorily "memorize" and retain as high as 15 million characters. The tape, once recorded, is storable and transportable. Its ability to remember information and reproduce it upon demand, without error, at high rates of speed is of prime interest.

2. *Ease of transfer.* Rate of transfer of data on or off the tape is done at electronic speeds. Magnetic tape is not hampered by mechanical elements which are operating at near performance limits. All of the elements, in spite of the high transfer rates, work at low and reasonable speeds. The only fast-moving items in the system are electrons and magnetic dipoles.

3. *Preservation of data.* The data recorded on the tape are kept in live electrical form. Hence, they can be dealt with by automatic equipment. Computers, wave analyzers, plotters and other analysis equipment can be fed directly from the tape. The original run is recreated in live form. Processing costs go down and the elapsed time between test and analysis is decreased.

4. *Tape is a mnemonic device.* Magnetic tape is excellent as a memory device. Older means of recording, such as photo-panel recording, or pen recording, cannot have the accuracy which is inherent in magnetic tape. Further, data can be stored indefinitely with magnetic tape.

5. *Time compression and expansion.* Using magnetic tape, it is possible to play tricks with time, much the same as can be done with motion picture photography. It is possible to slow high-speed data to a crawl. Conversely, very slow-speed data can be speeded up in order to facilitate analysis. Time expansions of 600 to 1 can easily be achieved. In the case of low speed phenomena, time can be compressed very easily. By recording at an extremely low tape speed, and then reproducing at a high speed, while re-recording on another machine at low speed, a 12-hour cycle can be

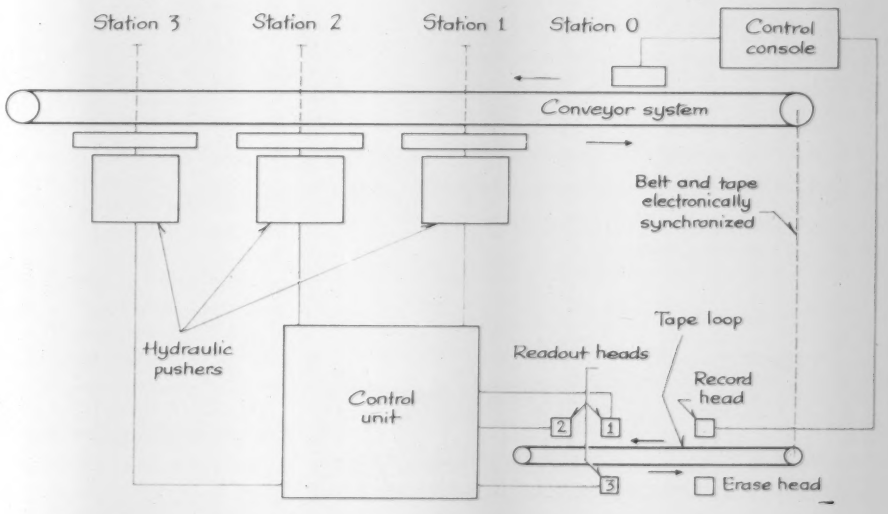


Fig. 1—In automatic sorting system, magnetic tape loop is used to store destination information impressed on tape when product unit is at Station O. Tape loop motion is synchronized with that of conveyor. When product unit arrives at Station 1, a readout head checks signal on tape. If signal is correct, a hydraulic pusher is actuated; otherwise, product unit will advance on conveyor until signal corresponds to a desired station destination. Signals are erased after sensing to permit continuous system operation.

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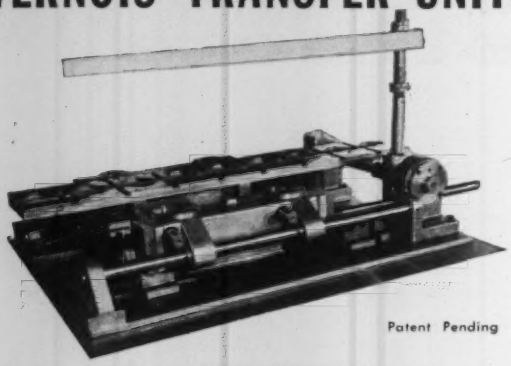

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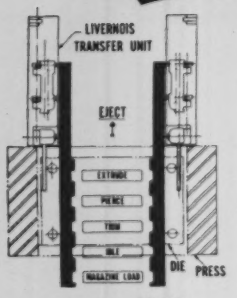


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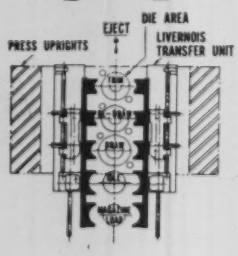


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compressed to 1.2 cycles per second.

6. *Time delay.* Magnetic tape can be considered to be a variable time delay element. The delay can be as short as seconds, or as long as weeks, months, or years. A loop recorder with a downstream reproduce head can be used with the head located so as to synchronize playback data with an external system. Hence, by means of synchronized time delays, the tape recorder may be used as a transport delay simulator.

### Fixed Program Applications

Use of magnetic tape recorders on numerically controlled machine tools has been well documented. Various types of storage media are used depending on the type of the system. In general, point-to-point systems use cards or punched tape input. Machines used for continuous contouring and milling utilize either punched tape or magnetic tape, depending upon the amount of information to be stored, and the type of equipment located at the machine tool. The storage of data on the tape in analog form generally leads to simpler control elements located on the machine. This is because interpolation of the data can be done in the computation lab and does not have to be done "on-line" at the machine. At the present time, most of the control systems use magnetic tape for programming.

A typical system employs 14 tracks of data on 1-inch tape wound on 7,200 foot reels. This amount of tape provides a playing time of approximately 1½ hours. During this period, several million data points are reproduced from a single reel of tape.

The machine tool control unit utilizes master tapes which are prepared on a computer. The computer generates the millions of points needed to define the path the cutting tool must follow. Five total axes can be controlled on a time-co-ordinated basis. The use of the computer technique makes it possible to create parts on a high speed basis which could not be machined under human control. Time co-ordinated recording makes possible simultaneous control of all axes. This is above and beyond the ability of a human operator, but presents no problem to a computer.

### Record Playback

Other program controlled systems do not require a computer. Simplified record playback control for systems is presently available. Information is recorded on the tape as a human operator goes through the motions of making a part. Tool slide motions are recorded on magnetic tape. After having gone through a complete manual sequence for part machining, the tape which has been prepared can be used to reproduce that part endlessly. Also, it is possible to edit this tape in order to eliminate the time required by the operator to plan his work. Hence, the tape reproduces the data with a minimum of lost time, and does so tirelessly and uniformly. This type of programming lends itself to small-quantity production of relatively simple parts. The use of program control of this type should result in improved quality and lower rejection rates.

It is possible to fabricate many parts from the same tape if it is so desired, since the tape itself has a long


Circle 715 on Page 19

life. The information on the tape can be duplicated and used to control other machines as well. The tape can be stored so that a library of parts can be built up. Techniques of this sort can result in reduced inventory requirements, since parts can be built on short notice.

A record playback technique has been adapted to jobs presently requiring skilled manual manipulation, such as painting, glazing, or assembly. Here, it is possible to economically release highly skilled labor by recording signals generated by skilled technicians. Once an original recording is made, the exact motions can be duplicated by the machine endlessly. It is also useful in industrial operations in obnoxious or extreme environments where human operators are subject to high temperature, smoke, soot, or noise. By means of tape, a small bit of man's intelligence can be captured and applied to the control of brute force—thereby relieving personnel for other more pleasant types of work.

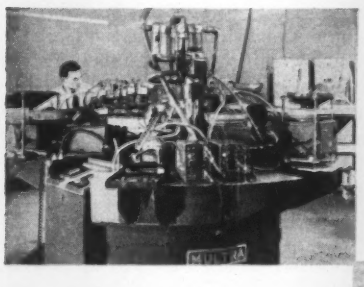
### Feed-Forward Concept

All of the above has dealt with program control involving a fixed program which is duplicated time after time in performing certain functions and operations in a desired time co-ordinated sequence. Another type of dynamic programming can be used. This can be used in feed-forward control systems. In the common feedback control system, the output of the system is measured, compared against a reference or standard, and a correction signal is fed back to effect a change in output so as to minimize the deviation of the product from the desired norm.

In a feed-forward system, operation is much the same except that information regarding the material is obtained before processing rather than after. In order to operate satisfactorily, this information must be presented with the proper time relationship existing between it and the material to be processed. This concept can be applied to many classes of application. For example, it could be used with machine tools teamed with gaging equipment, so that continuous corrections can be made in the tool path. It can also be applied to the automatic warehouse for conveyor programming, and for automatic dispatch control. It can be further applied to automatic processing such as automatic spraying equipment, and in the operation of flying shears or automatic sorting equipment, *Fig.* 1.

### Data Logging

Another interesting possibility exists for magnetic recording. This is for the logging of data. At the present time, much data is logged either manually or by use of various strip and circular-chart recorders. All of these data must be manually processed. Hence, because of the cost of processing, only limited amounts of information can be obtained. At the same time, computer techniques are being applied to various industrial control processes. The marriage of a digital computer and a magnetic tape data logger is logical.

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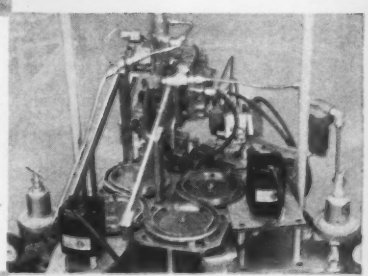

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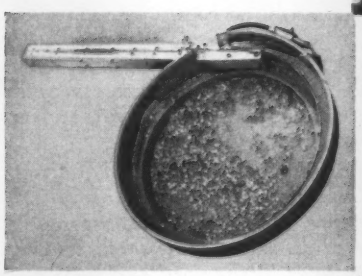

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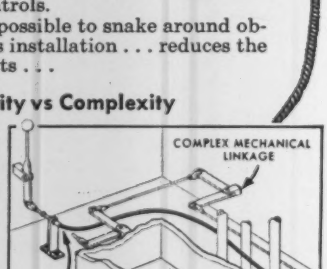


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By using some of the characteristics of tape described earlier, it is possible to provide equipment which will serve several functions. For example, 100 points can be scanned and their values recorded in far less than a second on an inch of tape. After the data are recorded on the tape, the tape recorder can stop in milliseconds. A minute later, or several minutes later, the same points can be sampled again and their values once more recorded on the tape. These data points can be logged for several hours.

In the interval between recordings, all of the readings can be reproduced into a computer, on demand, at a high rate of speed. The information is analyzed by the computer in order to determine trends that are in the controlled process and predict corrections which must be made. Any items of significant interest to operators can be automatically typed out on a log sheet. The information necessary to optimize control of the process is read into the computer from tape. The necessary actions can be taken to keep the plant within narrow operating limits. The information is recorded on an endless loop of tape so that, after the period of interest has elapsed, the tape is erased and fresh data are recorded. The tape always represents the status of the plant over the past several hours.

### Display and Fault Recording

Data on the tape can also be reproduced at high speed for use in visual display devices, such as oscilloscopes, so that an operator can observe the behavior of any given parameter over the period of the recording, and take any appropriate actions necessary, should problems develop.

Characteristics of tape which lend themselves to this type of recorder are: The ability to "remember" information; the ability to compress time; the ability to erase the memory and record fresh information; and the tape's ability to transfer data into a computer at high rates of speed (which makes it feasible to feed data into the computer in the intervals between recordings).

Another interesting application of a loop-type recorder involves fault recording. This is of great interest in the power industry. Very often, after a fault, it is desirable to analyze various voltages and currents in a system in order to determine the cause of a fault. Conventional pen recording equipment, even though capable of rapid starting, is not capable of capturing the events which lead up to the fault. Tape loop recording can capture data prior to, during, and after a fault so that the entire transient is on record.

To achieve full benefit from industrial use of magnetic tape control systems there is a great need for mutual education, not only of industrial control engineers, but also of the magnetic tape industry. We must learn the requirements, the language, and the philosophies of each other if we are to have successful ventures together. Without cross-fertilization it will be very difficult to achieve a workable arrangement.

*From a paper entitled "Some Aspects of Magnetic Tape Recording Useful for Industrial Control" presented at the Conference on Industrial Instrumentation and Control sponsored by Armour Research Foundation of Illinois Institute of Technology, Chicago, April* 1959.

## INDUSTRIAL POWER CONTROLS

By ARTHUR GUTTERMAN
President
Fairfield Engineering Corp.
Springdale, Conn.

EXAMINATION of present methods of variable control of 60 to 400-cycle ac power reveals that, with one exception, every method must do one of two things: Either use up some of the available power supplied from the line; or turn the line off for a part of the cycle, permitting it to remain applied only long enough to deliver a fraction of the power available in each half-cycle.

The exception is the variable autotransformer. This device transforms a fixed supply voltage into a variable output voltage to control the power delivered to a load. While it is usually operated manually, a reversible motor may be employed to permit remote operation or operation from low-level control signals. The autotransformer does not dissipate appreciable power and is therefore quite efficient. For jobs where the slow response of a motorized autotransformer is satisfactory, this device finds many applications in the power control field.

Control systems which dissipate power to cut down the amount sent to the load—such as those using power transistors, vacuum tubes, and rheostats—are suitable only for relatively small loads, of at most a few hundred watts. Even with this power consumption, they are relatively inefficient and costly to operate.

If the concern is with fast-response control of power ranging up to many kilowatts, resistance-controlled systems and the autotransformer may be dismissed. The various high speed switching devices which are currently in use for high power requirements may then be discussed exclusively.

### Types of Power Switches

There are five basic switches in use today: The thyratron, ignitron, saturable reactor, magnetic amplifier, and the solid-state controlled rectifier. All these devices work in essentially the same way. They are off (nonconducting) for part of the cycle, and turn the line on to the load at some point in time during a half-cycle. They have one other important characteristic—they automatically turn themselves off when the polarity of the line changes. That is, they permit current flow in only one direction after they turn on.

The output waveforms of all of these switches begin with a steep vertical rise at the point in time at which the device is turned on to connect the load to the power source. During the rest of the half-cycle, the waveshape follows that of the line. If the switch is fired (made to conduct) at, say, 90 degrees, half of the available power in the half-cycle is delivered to the load. If the switch is fired at 120 degrees, only a small amount of power (about 20 per cent) is available, while firing at the beginning of the cycle admits the entire half-cycle into the load.

The switches can be connected in several ways. By putting two of them "back to back," they will provide controllable, full-wave ac. By putting them in a bridge

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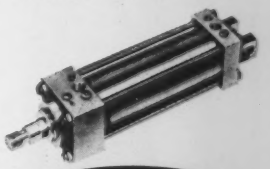

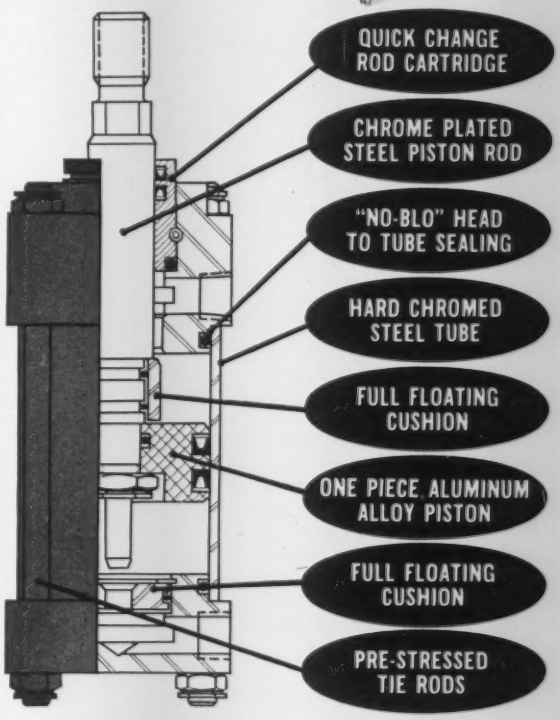
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Circle 718 on Page 19

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For example, vibratory parts feeders perform more efficiently on an engineered base permitting maximum power transmission. Either the side delivery or the elevating conveyor supply hoppers (with automatic paddle type relay switch to regulate delivery) hold large quantities of parts and are real labor savers. These are just a few advantages that make automation work and pay for itself.
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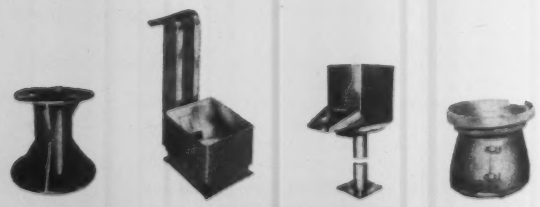

AUTOMATION DEVICES INC.
ERIE, PENNSYLVANIA

or a center-tapped transformer circuit, they can develop full-wave pulsating dc across a load. This pulsating dc can be filtered to provide smooth dc, if that is what the load needs.

### Principles of Operation

A detailed examination of the various types of switches will assist in pointing out their relative advantages and disadvantages:

1. The thyratron is a gas-filled triode which is fired by applying a positive voltage to its grid. This causes the gas to ionize and permit a heavy flow of current from cathode to plate.

2. The ignitron is a sort of scaled-up thyratron which handles much larger currents. The gas is mercury vapor, and the tube is fired by striking an arc between an ignition electrode and the cathode. This arc ionizes the mercury vapor and permits current to flow from cathode to anode.

3. The saturable reactor is essentially a coil of wire around an iron core. As long as the iron is unsaturated magnetically, the reactor presents a high impedance between the power source and the load. A control winding is provided through which a direct current can saturate the iron core. Saturating the core magnetizes the iron in one direction so that no further change of flux can take place. Thus, the iron is no longer useful in making the coil a high impedance and all that is left between the power source and the load is the impedance of the wire, which is very low.

The saturation process occurs during every half-cycle. At the beginning of each half-cycle, the iron is unsaturated and ready to be saturated again. The firing time depends on the magnitude of the dc current through the control winding. Varying this current controls the firing point, and thus the power delivered.

4. The magnetic amplifier is similar to the saturable reactor, except that the magnetic amplifier has a rectifier in series with the iron core so that the bulk of the dc needed to saturate the core is supplied by load current. The control winding has only a small job to do in determining the point in the cycle at which the iron becomes saturated. Thus, a magnetic amplifier can be considered as a magnetically controlled rectifier where the point at which the rectifier fires is determined by the control current through the control winding. This, in turn, determines the saturation point of the magnetic core.

5. The solid-state controlled rectifier has recently been made available to industry. It is essentially a rectifier, similar to the one used in the magnetic amplifier, but whose forward firing point is determined by a dc control signal in a gate. In the absence of a signal, the controlled rectifier will not fire and represents an open circuit. When the gate current exceeds a certain minimum value during a half-cycle the rectifier fires and conducts for the balance of that half-cycle. Power is controlled by varying the point during the half-cycle at which the gate is triggered by a dc current.

These five devices—thyratrons, ignitrons, saturable reactors, magnetic amplifiers, and controlled rectifiers—are the major means of power control available to the electronic and industrial fields. They are basically similar in that they are all switches, operating at the


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power line frequency, whose *On* time is controlled by the point in the half-cycle at which they are fired.

### Control Input Signals

Firing of saturable reactors and magnetic amplifiers is done directly by passing controlled currents through their control windings. The magnitudes of current in the windings determine the firing times.

In the case of thyratrons and controlled rectifiers, auxiliary devices are needed to generate input pulses of voltage or current at predetermined times during the half-cycles.

Ignitrons are generally fired by thyratrons. Therefore, the triggering device which determines the firing point of the thyratron also establishes the firing point of the ignitron.

Control signals can consist of ac voltages or currents, dc voltages or currents, or a combination of the two. Multiple input signals of either type may be applied. Magnetic amplifiers will accept any of these directly. Saturable reactors will accept only dc control inputs. However, available ac voltages or currents can be easily rectified and fed directly to saturable reactors.

The thyratron is fired whenever the grid exceeds a certain critical firing voltage and the anode is positive. The controlled rectifier is fired whenever the gate current exceeds a critical firing current during the time its anode is positive. For most thyratrons, the critical firing voltage is negative, while the controlled rectifier requires a positive gate current. Critical current or voltage is not an exact value. It varies with temperature, it varies from unit to unit and, in general, represents a critical firing *region*, rather than a point. Thus, to fire these devices at a precise time, a steep vertical wavefront of voltage or current is needed.

The output waveform of a magnetic amplifier provides just this steep vertical rise. Therefore, the magnetic amplifier is an ideal firing device for a thyratron tube or a controlled rectifier. It can handle either ac or dc input signals in a variety of power levels; it provides isolation between the input and the control device; any number of inputs completely isolated from each other may be algebraically added by the magnetic amplifier; and it is a control device with few elements.

By using magnetic amplifiers as control devices, dc control signals, either single-ended or polarity reversible, can be derived from thermocouples, strain gages, tachometers, and pressure transducers and fed directly into the control windings. Single-ended or phase-reversible ac control signals from synchros, resolvers, ac tachometers, and induction potentiometers can be fed into ac magnetic amplifiers of the reset type.

Multiple input signals, such as the sum of the outputs of several thermocouples, can be used to control a magnetic amplifier to indicate and maintain an average temperature instead of a temperature at one point. In another case, the speed and load of a variable speed drive can be compared in a magnetic amplifier that has several control windings.

*From an article "Present-Day Status of Power Control" which appeared in Fairfield Engineering News, a publication of Fairfield Engineering Corp., Springdale, Conn.*


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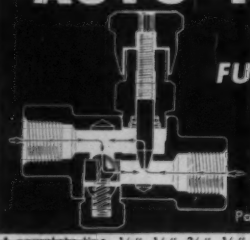

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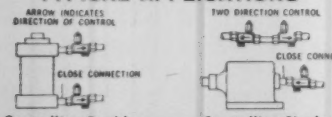


Controlling Double Acting Cylinder

Controlling Single Acting Cylinder

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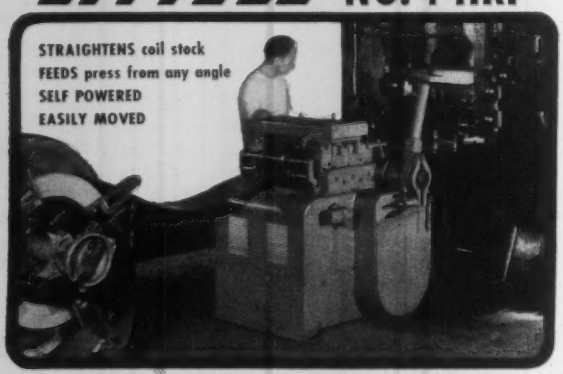
Circle 721 on Page 19

# LITTELL NO. 4 HRP




The straightening-feeding action of this HRP (Hydraulic Rack and Pinion Straightener-Feed) is synchronized to the speed of the press with one electrical connection. Two standard sizes for maximum stock width of 12" and 18" and thicknesses up to .125". (Special 24" width machines not stocked.) Standard 19" feed lengths double cycled to 38".

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4105 N. RAVENSWOOD AVE., CHICAGO 13, ILL.

Circle 722 on Page 19

are you stuck?

# confidential file

Readers with problems concerning systems, equipment, or components for automated operations are invited to outline them to: The Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio. Readers having solution suggestions are invited to submit them and should refer to case number and title of the problem involved. Dates shown with suggestions indicate issue in which the problem was presented.

CASE 1929-P

## LIGHT STRIP CUTOFF

. . . We are looking for a cutoff device to cut light coiled (copper) stock about 0.003 inch in thickness and from 1.320 to 2.660 inch wide into various lengths between 2 to 5 feet long. Accuracy on length can be plus or minus 1/32 inch. Rate of feed should be around 400 feet per minute. We also have a similar problem in aluminum stock in thicknesses of about 0.006 to 0.010 inch. We have been unable to locate an inexpensive cutoff to perform this work satisfactorily. . .

**Chief Manufacturing Engineer**

CASE 1950-P

## ELEVATING PELLETS

. . . We wish to handle calcium chloride in pellets approximately 3/8 through 3/4 inch in size. It is purchased in 350-lb drums and used in our dehydrators (20 to 22 feet tall). An operator has used a cradle on which he lifts the drums to recharge his unit. We are working on an arrangement to jet load a dehydrator by using a vessel with a capacity of three or four drums. We do not want to break or flake the material. We have pressure at the unit that could be applied to the storage side of the reserve chemical and jet it vertically some 22 feet into the top of the vessel. We trust you might be able to refer us to several companies having automatic equipment to handle pellets or materials similar to ours. . .

**Dehydrator Manufacturer**

CASE 1955-P

## HOT LIQUID PUMPS

. . . We would like to receive technical information from manufacturers of pumps capable of handling Ucon at 500 F, Aeroclor at 600 F, and Dowtherm at 750 F. We are interested in pumps having a capacity of from 10 to 50 gpm at around 100 psi. . .

**President**

CASE 1951-P

## BEVELING SHEET EDGES

. . . We are engaged primarily in the manufacture of petroleum storage tanks and pressure vessels. Carbon steel plates 3/8 to 1 3/4 inches thick, 48 to 120 inches wide, and 150 to 420 inches long are cycled through a burning operation in order to obtain a double bevel and nose cuts on one side and both end edges. This operation is performed

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Use WLS for production quantities up to 100,000 when low cost, fast delivery and possible design changes for virtually nothing, are important factors!

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*Circle 723 on Page 19*


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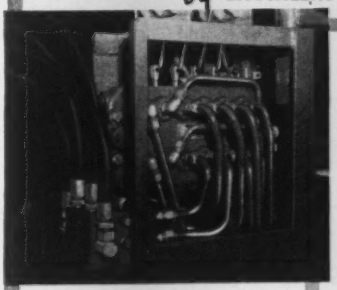
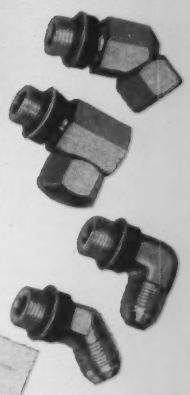
*Designed and Developed by ENGINEERS for ENGINEERS*



**Eastman**

"O" Ring Boss Fittings with Back-up Washer to prevent "O" Ring Extrusion



Eastman engineers cooperated in the pilot application of hydraulic hose assemblies on the power unit of this Sherman Power Digger shown above.

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Adapter Bulletin No. 500

**Eastman** MANUFACTURING COMPANY

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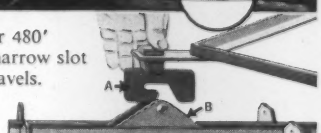
*Circle 725 on Page 19*


**AMERICAN "Chainless" in-the-floor conveyor tows bulky 1000 lb. loads!**

Metal floor plates cover 480' conveyor, except for a narrow slot in which the tow bar travels. Personnel or vehicles can cross the assembly line without stopping production. Write for Catalog CD-B.



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*Circle 724 on Page 19*


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**... THE COMPLETELY NEW AUTOMATIC PARTS WASHER AND METAL CONDITIONING MACHINE**

- Labor saving
- Automatic unloading
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The versatile new Simplicity VIBRA-WASHER, revolutionary machine for washing and conditioning of small metal parts, stampings and castings, employs a vibrating work carrier that automatically conveys parts through cleaning or conditioning bath. Solution is forced around parts, even into blind drillings and slots. In single stage, VIBRA-WASHER removes chips, oil and grease quickly . . . economically. In multi-stage, several units in line will provide cleaning, rinsing and phosphating, eliminating "between-stage" handling. Write today for Bulletin 107, to: Industrial Washer Division.

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*Circle 726 on Page 19*

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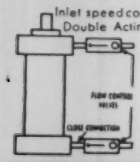


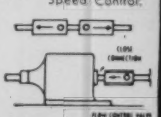


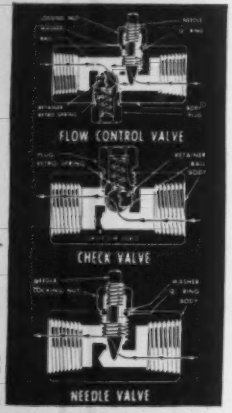


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*Circle 727 on Page 19*

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★ **Have you seen Avery's new pressure-sensitive Metallics for decorative trim, panels and identification plates?**

*Circle 728 on Page 19*


for welding purposes and is a rather slow method with its accompanying problems. In addition we have a plate planer which, production wise, has not proved satisfactory. Is there a machine which will yield bevel and nose cuts on plate edges with greater productivity and accuracy than conventional burning tables? . . .

**Manager Industrial Engineering**

**CASE 1956-P**

### VIBRATION ANALYZERS

. . . We are interested in the names of manufacturers of vibration analyzers. . .

**Chief Industrial Engineer**

**SUGGESTIONS FOR 1857-P (AUG. 1959)**

### TUBE TESTING

. . . We have been building tube testers for both air and hydraulic pressure since 1905. A standard machine could be adapted to solve this problem, and we would be glad to submit a price and design. . .

**G. F. Walker**
**Taylor-Wilson Mfg. Co.**

. . . The principal difficulty would be in obtaining a fast-acting positive seal. Since a flat seal would be cut rather quickly by the sheared end of the pipe, I would suggest a cup shaped seal of flexible material designed so that the rim would be closed against the exterior surface of the pipe by metal segments actuated by a tapered collar. Such a system would require separate seals for each pipe size. However, the seals could be designed in such a manner that the flexible cup would be changed without disturbing the collar. . .

**C. J. Smith**
**C. J. Smith & Co.**

**SUGGESTIONS FOR 1867-P (AUG. 1959)**

### COUNTING DRAPERY HOOKS

. . . It would appear that this problem can be handled with standard equipment. For a sensing device we suggest our photo head Model H-21-CM described in the enclosed catalog. The counting requirements can be taken care of with our Model P-2 counter . . .

**Lawrence A. Tibbetts**
**Post Machinery Co.**

. . . It would be much easier to evaluate this problem if we had sample hooks to experiment. We would be glad to evaluate this and any other problems . . .

**Edward M. Armstrong**
**Radio Corp. of America**

. . . I would suggest he consider some electronic tripping device that is activated by the weight of the fourteen drapery hooks . . .

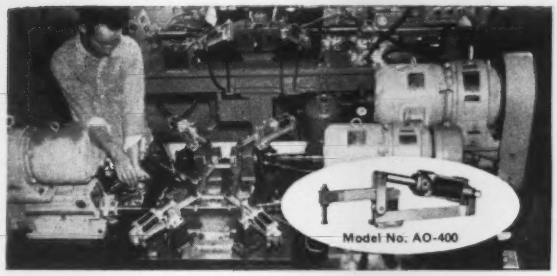
**W. A. Pearson**
**Royal McBee Corp.**

**SUGGESTIONS FOR 1891-P (AUG. 1959)**

### WEB REGISTRATION

. . . We are forwarding a copy of our brochure, Operating and Installation Instructions for Electro-Magnetic Pickups, which contains detailed information on installations, adjustment, output, wave shape, and general information. We are also forwarding a copy of our catalog and specification sheets which contain additional information of a general nature. . .

**G. P. Bothscheider**
**Electro Products Laboratories Inc.**

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*Circle 729 on Page 19*

## QUALITY DIE CLEANING at LOWER COST!

**NEW** HOLLOW SHAFT
SPRING RETURN • STUD MOUNT • 9/16" or 3/8" BORE

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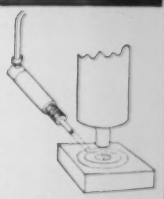
### AIR CYLINDERS



Having dirty die trouble? New Clippard HOLLOW SHAFT Spring Return MINIATURE AIR CYLINDERS can solve your problem quickly . . . inexpensively . . . and be used to lubricate dies at the same time!

In punch press diagram at right, CLIPPARD HOLLOW SHAFT cylinder is cycled to extend into bottom die on up stroke, blasting stream of air and mist of lubricant through hollow shaft. This kicks out chips and work piece and lubricates die for next punch. On down stroke of press, cylinder shaft retracts for clearance.

In automated circuitry and semi-automated work positions, the uses of Clippard MINIATURE Air Valves, Cylinders, Valve Solenoids, Accessories and Fittings are unlimited. Quality is high. Prices are reasonable. Send for complete literature on Clippard MINIMATICS, today.

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*Manufacturers of Miniature Pneumatic Devices, R.F. Coils, Electronic Equipment*

*Circle 731 on Page 19*

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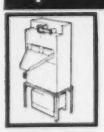

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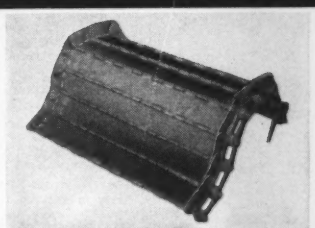

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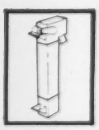

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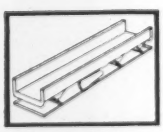

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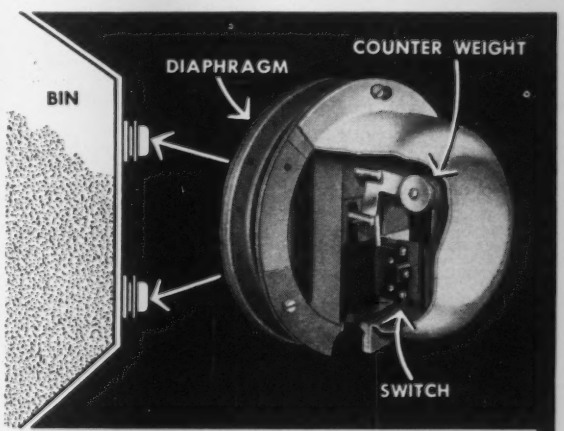


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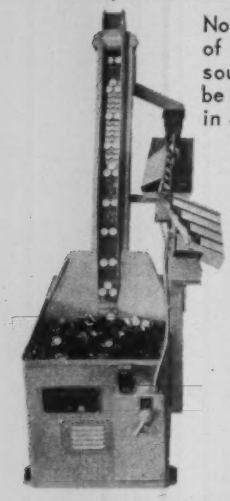

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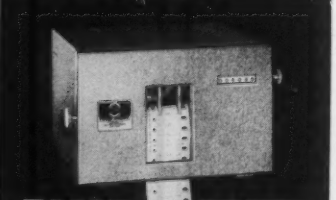

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AUTOMATION

# new books

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### BUSINESS INVESTMENT POLICY—A MAPI STUDY AND MANUAL

*Available from Machinery and Allied Products Institute, 1200 18th St. N.W., Washington 6, D. C.; 250 pages, 8½ by 11 inches;* $10.00.

Book is divided into four main sections. Part I contains background discussion; Part II presents theory of the new MAPI analysis system; Part III is an instruction manual for use of this system; and Part IV discusses top management problems regarding investment policy. Examples are included to illustrate the application of the system. Appendixes present information on comparison of the old and new MAPI formulas and the derivation of the formulas, plus other data.

### DEFINITIONS OF REGULATOR CAPACITIES

*Available from Fluid Controls Institute Inc., 320 Broadway, New York 7, N. Y.; 8 pages, 8½ by 11 inches; 20 cents.*

Standard FCI 58-1 defines terms related to self-actuated regulators used to regulate pressure, temperature, liquid-level, or differential pressure. Formulas and methods to determine flow capacities are given.

### WELDING HANDBOOK—SECTION II

*Available from American Welding Society, 33 West 39th St., New York 18, N. Y.; 562 pages, 6 by 9 inches, illustrated;* $9.00.

Fourth edition of the Welding Handbook is being divided into five sections. Section II includes Chapters 21 through 33 and covers gas, arc, and resistance welding processes as well as standard welding symbols. Equipment, materials, applications, and fundamentals are discussed for each process.

### DIMENSIONAL STANDARDS FOR SEMI-TUBULAR RIVETS

*Available from Tubular and Split Rivet Council, 53 Park Place, New York 7, N. Y.; 4 pages, 8½ by 11 inches; no charge.*

Standard covers body diameter and head dimensions for oval head, truss head, and flat countersunk head types of semi-tubular rivets.

### STANDARD SPECIFICATIONS FOR ELECTRIC WIRE ROPE HOISTS

*Available from Hoist Manufacturers Association Inc., One Thomas Circle, Washington 5, D. C.; paperbound; 9 pages, 8½ by 11 inches.*

Booklet defines and spells out recommended minimum specifications for electric wire rope hoists. Basic information is outlined which should be included in inquiries for hoists.

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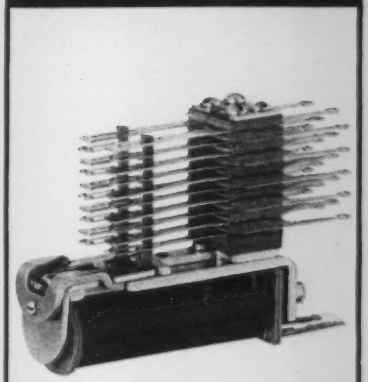

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***Type BB:*** *relay accommodates up to 100 Form "A" springs.*

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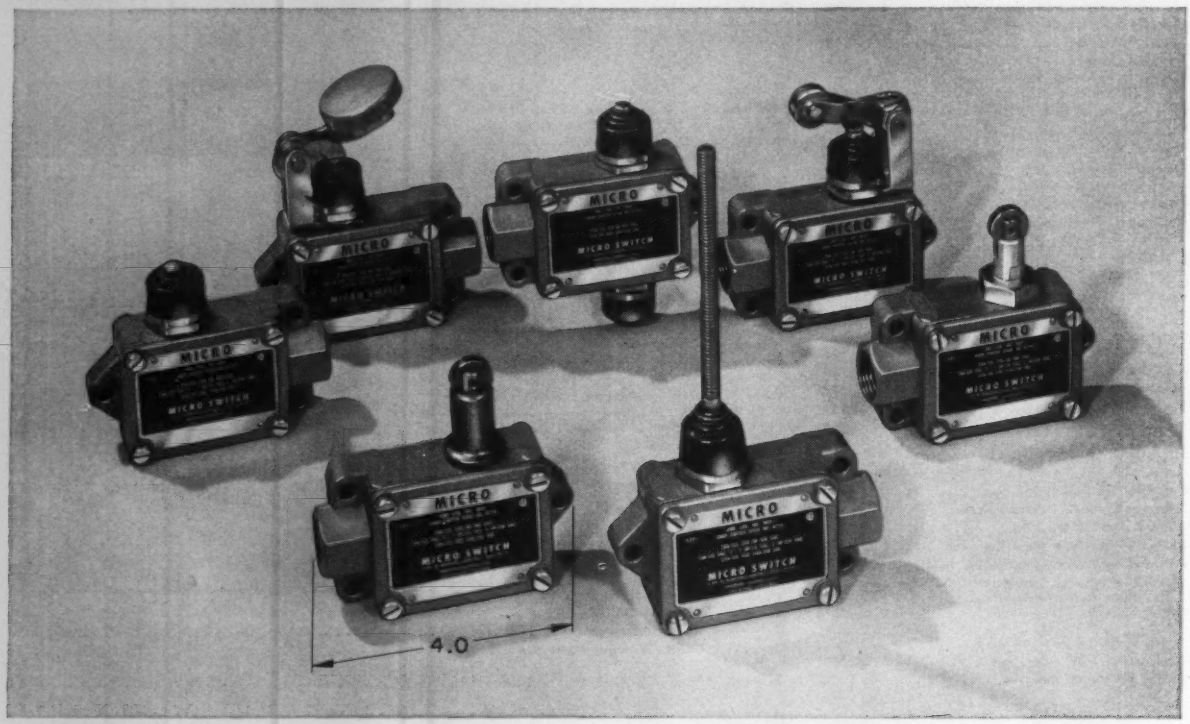
MICRO SWITCH Precision Switches




# These high-capacity "BAF1" switches seal out dust, oil, and moisture

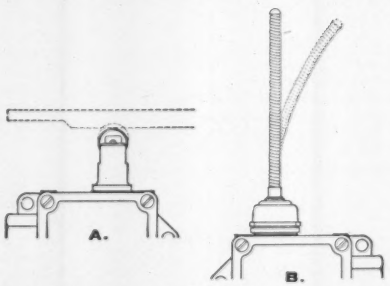
MICRO SWITCH "BAF1" enclosed switches are protected from physical damage by sturdy aluminum cases, and from oil, dust, dirt, and water by an O-ring seal between the case and the cover plate, and an elastomer boot around the plunger. Mounting holes accept ¼-inch bolts.

These high-capacity switches make and break steady state currents of 20 amperes and switch inrush currents as high as 75 amperes. The "BAF1" Series is especially suitable for heavy-duty industrial applications.

"BAF1" switches have single-pole double-throw contact arrangements. The switches may be used either normally-open or normally-closed. Available in either left hand or right hand mounting designs.

Consult the Yellow Pages for the name of the distributor near you. Send for Catalog 83.

Underwriter's Laboratories listing: 20 amps, 125, 250, or 460 vac; ½ amp, 125 vdc; ¼ amp, 250 vdc; 1 hp, 115 vac; 2 hp, 230 vac; 10 amps, 125 volts when controlling tungsten filament lamp loads on a-c circuits.




Sealed roller plunger actuator (A) can be adjusted horizontally through 360° permitting operation from any direction. Actuator shaft is protected by internal O-ring seal. Flexible coil spring actuator (B) can be operated from any angle except direct pull.

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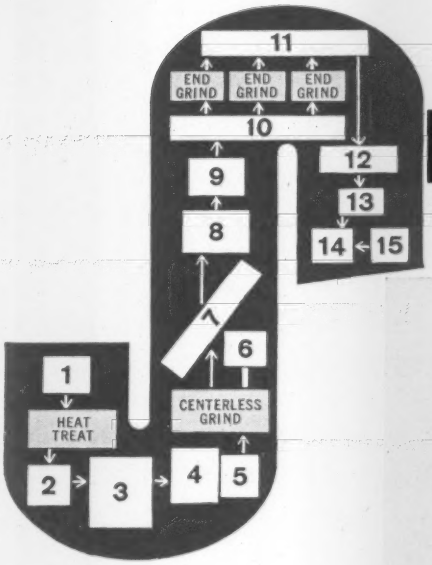


Flow diagram showing typical applications of

## RCA AUTOMATION

1. RCA Floor Feeder
2. RCA Elevating Orienting Feeder
3. RCA Automatic High-Speed Hardness Testing Machine
4. RCA Floor Feeder
5. RCA Rotary Hopper
6. RCA Grinder Control
7. RCA Transfer Conveyor
8. RCA Non-Mar Feeder
9. RCA Mechanical Orienting Machine
10. RCA Demand-Feed Conveyor
11. RCA Conveyor
12. RCA Final Inspection Machine
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14. RCA Automatic Assembly Machine
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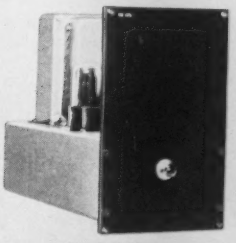
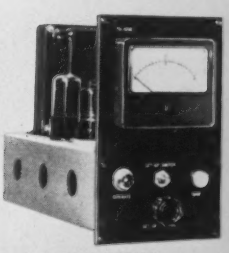
THYRATRON


POWER SUPPLY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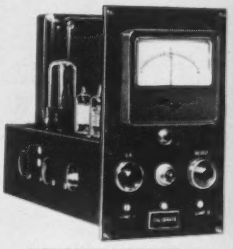
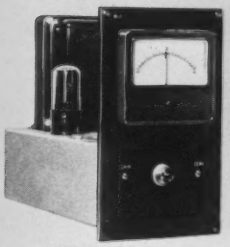
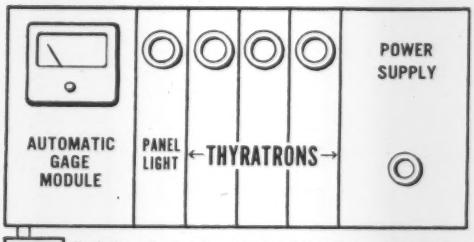

DIFFERENCE COMPUTER


SUM COMPUTER

With these standard precision-engineered electronic modules, now available from RCA, you can build automatic systems to meet your exact gaging needs.

Easily assembled, such systems offer high reliability, 100% repeatability, and unusual accuracy. These same modules are now being incorporated in numerous RCA automation systems in use throughout the metal working industry, in such applications as automatic grinding controls, hardness testing, and the inspection of pistons, pins, ball and roller bearings.




Typical application for checking O.D. in four classifications. More complex systems can be assembled by incorporating additional modules such as a DC-7 Difference Computer and Sum Computer.

**AGMC GAGE MODULE** (includes gage head and coaxial cable): transforms the electronic changes caused by displacement of a gage tip into a directly useable signal requiring no amplification.

**ATM THYRATRON:** energized by AGMC output, provides a limit signal used directly for actuating segregating gates and marking or stamping devices.

**APS POWER SUPPLY:** feeds up to five thyratron modules.

**DC-7 DIFFERENCE COMPUTER:** subtracts signals from AGMC units and provides a reject signal. It is used for calculating taper, parallelism, squareness, and similar characteristics.

**SC-7 SUM COMPUTER:** calculates over-all dimensions determined by individual measurements of two segments.

*Write for further information.*

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INDUSTRIAL AND AUTOMATION DIVISION
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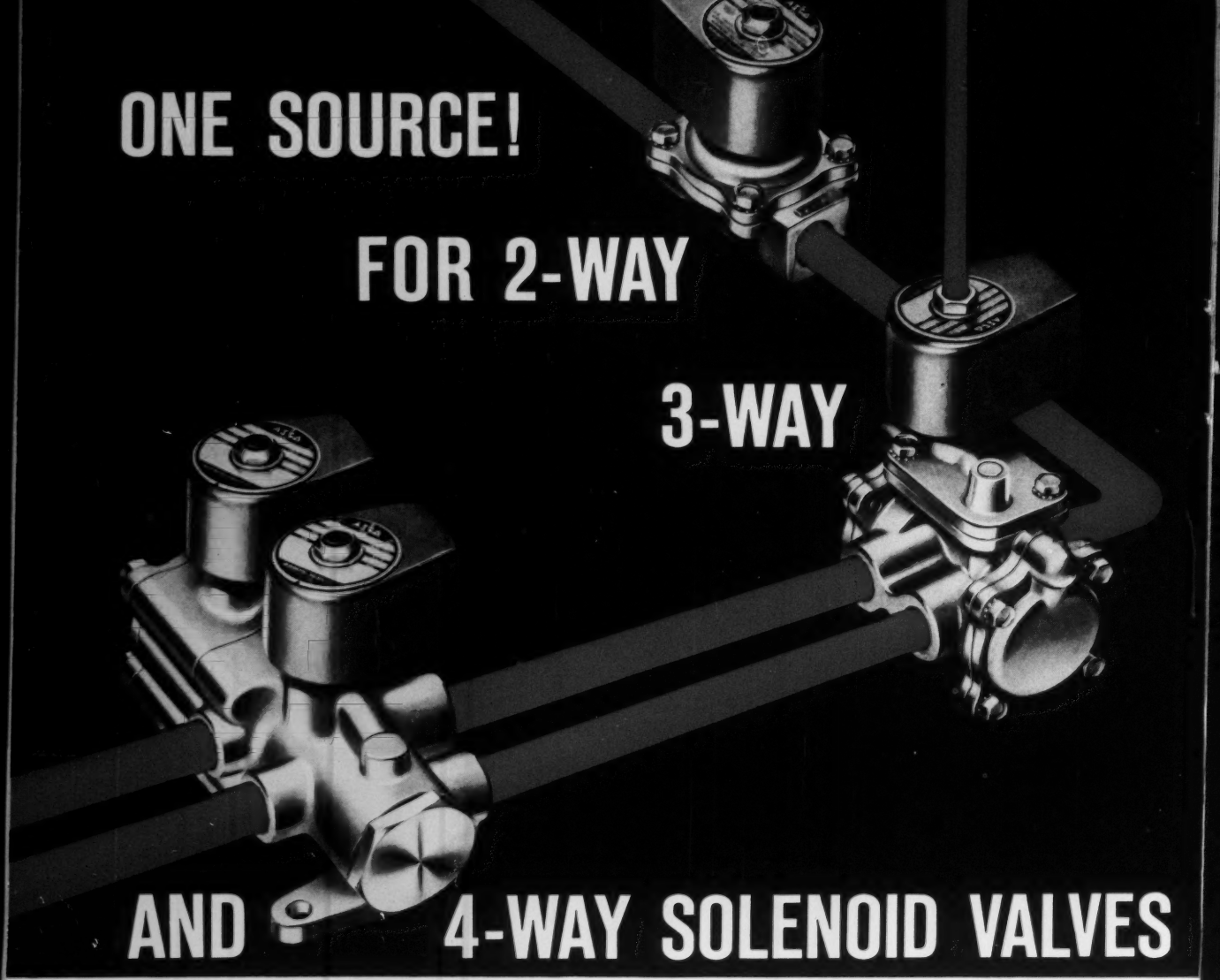


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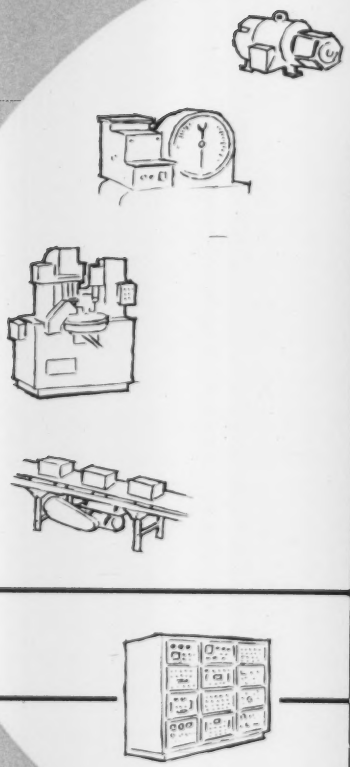
# AUTOMATION



# annual product review

FIRST ANNUAL EDITION
ISSUED OCTOBER 1959

OCTOBER 1959

AUTOMATION

A PENTON PUBLICATION

*The Magazine of*
*Automatic Manufacturing Operations*

# ANNUAL PRODUCT REVIEW

"If I could get my hands on that product catalog I saw a few months ago . . . I could show you all the specifications and details you need." Does this sound familiar when an important job is at hand and you're looking for detailed, accurate product descriptions? If so, then we think you'll be particularly interested in the information contained in this first edition of our Annual Product Review.

This is another special reader service by AUTOMATION. It offers you a complete, concise review of automation equipment, products, components and services advertised in AUTOMATION during the past 12 months. If you're looking for easy-to-use product information, you'll want to study this 1959 Annual Product Review. It describes over 400 separate items and tells you where to get complete information about them. As an extra convenience, each item is indexed for easy reference.

For the first time, from one source, you can get useful automation information . . . helpful data to help solve your automatic manufacturing problems. The inquiry post cards make it easy to request free literature or product information. When you spot something that you would like to know more about, simply circle the number on the Inquiry Card. With no obligation on your part, you'll receive the information direct from the manufacturer in a short time.

Keep this Annual Product Review handy, and refer to it when you need product information.

# 1959 ANNUAL PRODUCT REVIEW

For your convenience, each item mentioned in this booklet can be quickly identified by an Item Number which is shown in the following Product Index. Company index starts on page 17.

For additional free information, circle Item Number on an Inquiry Card. Fill in your name, title, company, etc., and mail. Your request will receive prompt attention and will be filled directly by the manufacturer.

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**LUBRICATION SYSTEMS**—Farval Corp. Centralized systems of lubrication for all types of metalworking machinery. Measured amounts of lubricant sent to all bearings from a safe, centrally located pumping station. Bulletin 26-S on request.

Circle 401 on Page 19

**LUBRICANT APPLICATION DEVICES**—Lincoln Engineering Co. Catalogs 92 and 811 describe Lincoln's Lubricant Application equipment from push-button-power lubrication to surface-check grease fittings.

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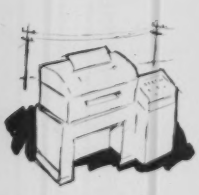

## Communications

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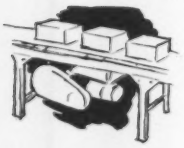

## Conveying and Transporting

**VACUUM HANDLING**—Vac-U-Lift Company. Vac-U-Lift Systems quickly, economically and safely solve difficult handling problems regardless of weight, shape or size. Illustrated brochure shows some of the many systems now in use. Explains how Vac-U-Lift works and how you can take advantage of its 3-step analyzation service without cost or obligation.

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**PREHEATERS**—Fuller Co. Humboldt Suspension Type Preheaters for preheating dry, pulverized Portland cement raw materials with rotary kiln waste gases.

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**VANE TYPE FEEDER**—Fuller Co. Handles dry, pulverized and granular materials. Capacity ranges to meet all normal plant requirements. Built with circular or rectangular outlets. Literature available for the full specs.

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**SCRAP REMOVAL**—May-Fran Engineering Inc. Facts Bulletin MF-640 covers May-Fran's Chip-Tote machine tool accessory. Cuts production costs, permits longer "run" times for your automatic machines. Conveyor can be synchronized with the metal removing capacity of the machine.

Circle 408 on Page 19

**FLOOR-MOUNTED CONVEYOR**—May-Fran Engineering, Inc. Catalog MF-100 describes May-Fran's "moving sidewalk" conveyor which is floor-mounted to permit perfect handling and deflection of parts and containers with irregular surfaces without damage to the parts or belt.

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**CONVEYORIZED PACKAGING**—Metzgar Conveyor Co. Save up to 70% on handling costs. Hi-Lo Packaging Station with power belt conveyor furnished in standard 18″; 22″; 30″ O.A. Belt widths 12″; 16″; and 24″. Lengths to suit. Used with gravity roller or whole conveyors.

Circle 410 on Page 19

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Circle 411 on Page 19

**CONVEYORS**—Simplicity Engineering Co. Model 36 conveyor is designed to meet the needs of manufacturers who

do not require the capacity of heavy duty conveyors. Five different pan widths—4" to 12". Stocked in 5' and 10' sections. 14" in over-all height. Requires ¾ hp to 1½ hp motor.

**Circle 412 on Page 19**

**AUTOMATIC PARTS WASHER**—Simplicity Engineering Co. Vibra-Washer—completely new automatic parts washer and metal conditioning machine. Automatic unloading. For single or multi-stage operations. No nesting of parts during cleaning or conditioning cycles. Bulletin 107 gives the complete story.

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**FLASK HANDLING AUTOMATION**—Anchor Steel & Conveyor Co. Imaginative engineering solved foundry industry handling problems. Anchor's engineers stand ready to assist you in your industry. Complete case histories available.

**Circle 417 on Page 19**

**PUSHBUTTON PACKAGE HANDLING**—Alvey Conveyor Mfg. Co. engineers new methods that minimize handling, speed work flow and increase profits through automated conveyor systems.

**Circle 418 on Page 19**

**OVERHEAD CONVEYING SYSTEMS**—Richards-Wilcox Mfg. Co., Material Handling Div. "Twin-Trak" systems consist of one or more power tracks and as many storage or free tracks as desired, plus the necessary switches, carriers and power equipment.

**Circle 419 on Page 19**

**CHAINLESS CONVEYOR SYSTEMS**—American MonoRail Co., Conveyor Div. Cable-way conveyors with nylon wheels are fast & easy to install. Grease lubrication is minimized. Handle up to 250 lbs. per trolley.

**Circle 420 on Page 19**

**PLANTWIDE CONVEYING SYSTEMS**—Alvey-Ferguson Co. offers semi and fully automated conveying systems for all industrial applications. A-F engineers the right type of system for your needs. Complete details available.

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## Storage and Transfer

**SAVE FLOOR SPACE**—Chicago Tramrail Corp. Valuable floor area is saved with Trak-Rak Systems by permitting vertical material storage and handling. Safer and faster than on the floor operations. Information available.

**Circle 422 on Page 19**

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**Circle 423 on Page 19**

**HANDLING**—Gear-O-Mation, Div. of Michigan Tool Company. Pre-engineered automatic parts-handling units that save you money. Whether you're automating a single machine or a full line, Gear-O-Mation has the pre-engineered equipment to do the job—properly and inexpensively.

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**AUTOMATION IDEAS**—Gear-O-Mation, Div. of Michigan Tool Company. "Automation Idea File" contains sketches and details of practical answers to many parts handling problems—orienting, feeding, positioning, conveying, distributing, etc. Receive your copy now.

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**Circle 426 on Page 19**

**CONTROL PANELS**—Fuller Co. Permit automatic, remote, one-man control of multiple operations. Easily-read panel permits visualizing flow of material to storage or from process bins.

**Circle 427 on Page 19**

**GRATE COOLERS**—Fuller Co. Horizontal and Inclined Grate Coolers are compact, easily installed for fast, efficient cooling of materials from 2800° F to almost any desired point.

**Circle 428 on Page 19**

**MATERIAL-LEVEL INDICATORS**—Fuller Co. Signal audibly and visibly when materials reach a predetermined high or low level. Control conveyor motors, valve circuits, etc.

**Circle 429 on Page 19**

**TUBULAR CONVEYORS**—Hapman Conveyors, Inc. Tubular Conveyors for bulk material handling. Move almost any flowable material wet or dry . . . through any plane or angle. Write for additional information.

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**CONVEYORS**—Logan Co. Sales begin in the shop. Logan conveyors have been the key to greater savings in time, space and effort for large companies and small for over a half century. Ask for catalogs on belt, slat and trolley conveyors.

**Circle 431 on Page 19**

**MATERIALS HANDLING SYSTEMS**—Louden Machinery Co. New 52-page book, "Economical Material Handling", gives the latest information on the best in modern materials handling. Louden monorail, cranes, Selectomatic, carriers, and weighing dorries are covered.

**Circle 432 on Page 19**

**BUCKET ELEVATING CONVEYOR**—Lynch Corp. Robo-Lift's stainless steel buckets are ideal for food processing plants. Easy to keep clean, help keep products pure. Overlapping edges prevent spilling—ease housekeeping problems. Six-page folder tells the complete story on Robo-Lift at General Mills.

**Circle 433 on Page 19**

**CONVEYOR SYSTEMS**—Mathews Conveyer Co. Whenever unnecessary handling increases costs in processing, warehousing or shipping, Mathews can job-fit a system to your plant efficiently. Catalog 856 gives complete details.

**Circle 434 on Page 19**

**WHEEL AND ROLLER CONVEYORS**—The E. W. Buschman Company. Conveyors that give you low initial and operating costs with proved dependability. Light, medium and heavy duty conveyors are adequate for a wide range of handling applications. Write today for literature.

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**Circle 436 on Page 19**

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**AUTOMATIC DISPATCH SYSTEMS**—Cleveland Crane and Engineering Co., Cleveland Tramrail Div. Special report, "Automatic Dispatch Portfolio" gives data on a variety of cost-reducing automatic handling installations.

**Circle 438 on Page 19**

**MAGNETS IN AUTOMATION**—Eriez Mfg. Co. Magnetic units to move materials faster more economically, more efficiently and accurately. 56-page booklet, "Magnetic Ideas for Automation" on request.

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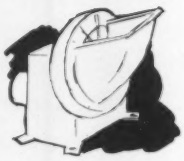

## Feeding, Dispensing and Placing

**FEEDING-STRAIGHTENING MACHINES**—F. J. Littell Machine Co. Littell machines feed the press or shear accurately from any direction right to left or front to back. Can be positioned at odd angles to produce odd-shaped parts. Handle a wide range of stock widths and thicknesses. Catalog gives full details.

**Circle 440 on Page 19**

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**BEARING FEEDER**—Feedall, Inc. New catalog, "Increased Production," gives interesting details to help your bearing production move faster at lower cost.

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**AUTOMATIC GAGING MACHINE**—Feedmatic-Detroit, Inc. Measures and sorts parts. Adjustable stops, anvils and gageheads to facilitate changeover to different size parts.

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**VIBRATORY PARTS FEEDERS**—Automation Devices, Inc. Peeco Div. Vibratory parts feeders for equipment, machinery, production or assembly lines reduce costs. Details on request.

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**AUTOMATIC MOLD HANDLING SYSTEM**—Planet Corp. Planet engineers automate many types of production lines, build bulk and unit materials handling systems, design complete plants. Experts on all types of special handling and automation machinery.

**Circle 451 on Page 19**

**FEEDERS**—Radio Corp. of America, Industrial & Automation Div. Elevating Orienting and Non-Mar Feeders handle a wide range of part sizes and shapes as well as oriented feeding of fragile or highly finished parts.

**Circle 452 on Page 19**

**VIBRATION INDUCERS**—Martin Engineering Co. Vibrolator, vibration inducers, is the world's quietest vibrator. Only one moving part—a rolling ball. Works perfectly on wet or dirty air. Needs no lubricator. Guaranteed self-starting always. Catalog on request.

**Circle 453 on Page 19**

**FEEDING DATA BOOK**—Vibratory Feeder Company. Booklet has tremendous storehouse of parts feeding information. Make use of it and produce more—automatically. If you have a parts feeding job pending, the chances are the answer is in your VFC Sales Engineers Data Book. Write now for your copy.

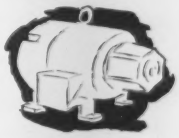
**Circle 454 on Page 19**

**FEED TRACK**—Campbell Machines Co. Campbell "Open-Flex" feed track installs in 1/10th the time of rigid track. Continuously feeds reciprocating tooling. Virtually damage-proof.

**Circle 455 on Page 19**

**PARTS HANDLING**—F. Jos. Lamb Co. Cut costs, save time and money by eliminating special design and provide flexibility in your parts handling equipment by standardizing on Lamb's concept of "packaged" automation. New bulletin gives numerous ideas on cutting parts handling costs

**Circle 456 on Page 19**



## Electric Motors

**DC MOTORS**—Reliance Electric & Engineering Co. Reliance Super "T" puts Dynamic Response into starts, stops and speed changes. 50% increase in torque—50% decrease in reaction time. Can develop double normal horsepower during starts, stops and speed changes.

**Circle 457 on Page 19**

**ELECTRIC MOTORS**—Reuland Electric Co. New General Catalog gives details on Reuland's two-speed reversing duty motor containing an internal fluid coupling, gear reducer and magnetic brake.

**Circle 458 on Page 19**

**TORQUE MOTORS**—Peerless Electric Co., Electric Motor Div. New bulletin outlines basic facts about Peerless torque motors. Ratings from 2 oz in. to 200 lb ft. All standard frame sizes; all types of mountings and Class A, B, and H insulation are available.

**Circle 459 on Page 19**

**A-C MOTOR**—Westinghouse Electric Corp. Reliable Westinghouse Life-Line "A" a-c motor, part of Rectiflow, combines Bondar, Bondite, and Mylar insulation for long life. Prelubricated, factory-sealed bearings eliminate need for lubrication—keep lubricants in, dirt out. Complete specifications are available.

**Circle 460 on Page 19**

**D-C MOTOR**—Westinghouse Electric Corporation. New Westinghouse Life-Line "H" d-c motor, with revolutionary silicone insulation, gives ten times longer insulation life. New compact design gives faster response. Complete specifications available.

**ELECTRIC MOTORS**—Baldor Electric Company offers Stream-cooled motors for general use or for specific applications demanding the most exacting requirements. Motors give top efficiency from your equipment while holding costs to

**Circle 461 on Page 19**

**FREE INFORMATION & LITERATURE**

For more information about any product or useful literature mentioned in this issue, simply circle the item numbers on the Inquiry Card on page 19. Fill out and drop the postage free card in the mail today.

a minimum. A complete line of motors that will solve your power problems. Color catalog on request.

Circle 462 on Page 19

**BRAKE MOTOR**—Cleveland Electric Motor Co. Quick-releasing, fast-braking brake motor simplifies machine starting and stopping. Solenoids and coils eliminated. Data available.

Circle 463 on Page 19

**CLUTCHES AND BRAKES**—Eaton Mfg. Co. New illustrated bulletin gives complete description and specifications for Eaton Dyna-torq stationary field clutches and brakes, available in a full line from 1¾" to 15" diameter.

Circle 464 on Page 19

**ADJUSTABLE SPEED DRIVES**—Eaton Mfg. Co., Dynamatic Div. Dynamatic's Adjust-Speed Drive for any application from ¼ hp at 1650 rpm through 1 hp at 3200 rpm. Bulletin K-2-159 is now available with full details.

Circle 465 on Page 19

**AC MOTORS**—General Electric. Small, Quiet, Constant Speed AC Motors. Save space and weight with these dependable AC Motors. Provide long life with minimum service costs. Descriptive bulletins available.

Circle 466 on Page 19

**BOOKLET ON "WHY D-C?"**—General Electric. A new booklet written for modern industry's management team. Complete details on DC Drives for precise control. Your answer for more automatic, lower cost means of production. Write today for full details.

Circle 467 on Page 19

**SMALL DC MOTORS**—General Electric offers small D-C Motors 1/100 to 1 hp. Speeds of 860, 1140, 1725, 3450 rpm. Voltages: 32, 115, 230 volts. Windings: compound, shunt, and series. Offer long life, high efficiency, quiet operation. Bulletin gives full details.

Circle 468 on Page 19

**DC MOTORS**—General Electric. Bulletin GEA-6355 gives complete details on new General Electric DC Kinamatic Motors. A new standard in industrial direct-current motors that offer a reliable key to successful automation. Designed to meet the vital power load requirements of modern manufacturing methods. Write today.

Circle 469 on Page 19

**DC HIGH POWER SERVO MOTORS**—General Electric D-C High Power Servo Motors for high performance servo applications. Fast response, variable speed, small size. Write today.

Circle 470 on Page 19

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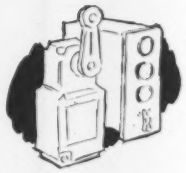

## Electric Controls

**POWER TUBES**—Radio Corp. of America, Electron Tube Div. Booklet PG-101-C covers RCA power tubes, thyratrons, rectifiers, ignitrons, magnetrons, and vacuum-gage tubes. Available in wide choice of power and frequency ranges.

Circle 471 on Page 19

**TIMING RELAYS**—Allen-Bradley Co. Pneumatic Timing Relays with silver alloy contacts provide maintenance free operation. Fluid Dash pot, motor driven and electronic types also available. Bulletins give case histories.

Circle 472 on Page 19

**PHOTO TUBES**—Radio Corp. of America, Electron Tube Div. Booklet CRPD-105A covers RCA gas and vacuum phototubes, photosensitive devices, and cathode-ray tubes available in a variety of spectral responses and sensitivity ratings.

Circle 473 on Page 19

**PRINT-OUT RECORDER**—Standard Instrument Corp. Tally-Print counts practically anything—prints totals on tape at periodic intervals and shows accumulated totals visually. Catalog LT-4 gives full details.

Circle 474 on Page 19

**MINIATURE CLUTCHES**—Stearns Electric Corp. Stearns electro-magnetic miniature clutches now available in 6 standard sizes, from ⅞" to 4¼". Torque from 25 oz in. to 240 lb in. Bulletin #504-BQ on request.

Circle 475 on Page 19

**FLOOR MOUNTED BRAKES**—Stearns Electric Corp. Stearns electro-magnetic disc floor mounted brakes quietly stop individual shafts or motors fast. Over 40 sizes from 1 to 575 lb ft max torque in 6 standard styles. Drip-proof or waterproof enclosures. Bulletins 226-H and 3502-Q on request.

Circle 476 on Page 19

**TIME RECORDER-TOTALIZER**—Standard Instrument Corp. Brochure LR-3 describes the Standard time recorder-totalizer that automatically records "on-off" time of any machine or process. Information is marked on continuous, time-indexed tape. Marking stylus is electrically actuated. Tapes run 4 months.

Circle 477 on Page 19

**ELECTRIC COUNTER**—General Controls Co., Production Instruments Div. Electric counter gives 200 million count life with DC operating reliability from AC through built-in

rectification. Speeds to 1,600 cpm. Dust-tight enclosure. Catalog on request.

**Circle 478 on Page 19**

**PROCESSS CONTROL SYSTEM**—GPE Controls, Inc. The Libra-trol-500 Process Control System is developed around a highly reliable, rapid-response digital computer. Provides a full range of process control. Information available.

**Circle 479 on Page 19**

**SOLENOID STARTERS**—Allen-Bradley Co. makes 9 sizes (0 to 8) of solenoid starters with only one moving part to eliminate trouble. Complete details and case histories are available.

**Circle 480 on Page 19**

**PRESSURE SWITCHES**—Allen-Bradley Co. For machine tool hydraulic systems operating at pressures up to 5,000 psi, A-B designed an oil-tight high pressure switch with no contact chatter.

**Circle 481 on Page 19**

**MEASURING RELAYS**—Assembly Products, Inc. API very high sensitivity measuring relays provide close tolerance performance on very tiny currents. Bulletin 104-D gives the complete story.

**Circle 482 on Page 19**

**TELEPHONE HANDSETS**—General Dynamics Corp., Stromberg-Carlson Div. "Push-to-talk" telephone sets, of most modern design, come in two styles. 1.) Short, lightweight. Comes with capsule-type receiver and transmitter. 2) Push-to-talk handset. Rocker-bar switch with various spring combinations. Handset Bulletin T-5005 on request.

**Circle 483 on Page 19**

**ELECTROHYDRAULIC VALVE ACTUATORS**—GPE Controls, Inc. GPE Controls Electrohydraulic Valve Actuators combine the speed and positive action of hydraulic valve operation with the flexibility of electrical control and signal transmission. Write for more information on a complete line of controls.

**Circle 484 on Page 19**

**DELAY PUSHBUTTON**—Allen-Bradley Co. has just introduced seven new pushbutton and central units to its already large line. Publication 6090 describes the features of these new units which include a time delay pushbutton where delay is adjustable from 0.5 seconds to 5 seconds.

**Circle 485 on Page 19**

**REVERSING DRUM SWITCHES**—Allen-Bradley Co. Publication 6091 gives the story on A-B's all new drum switches. Misalignment and binding cannot occur with these modern designed switches.

**Circle 486 on Page 19**

**MOTOR CONTROLS**—Allen-Bradley Co. Trouble causing bearings, pins, and pivots have been eliminated in the A-B one moving part controls. Simple solenoid design and double break, silver alloy contacts never need service.

**Circle 487 on Page 19**

**DISC BRAKES**—Stearns Electric Corp. Stearns electromagnetic disc brakes for stub, extended, or through-shaft applications on motor ratings from 1/6 to 2 hp. New torque range from 1½ to 15 lb-ft. Complete data available in Bulletin 3402-Q.

**Circle 488 on Page 19**

**MICROMINIATURE RELAYS**—Potter & Brumfield Inc. New P&B crystal-case size relays show amazing shock and vibration capabilities. Absorb shocks of 100g and vibrations 30g to 2000 cps, without contact openings.

**Circle 489 on Page 19**

**ELECTRIC FLOW TRANSMITTER**—GPE Controls, Inc. This is a completely new idea in flow signal transmission. Completely transistorized, without complex mechanics, it transmits a high-level signal proportional either to flow or to differential pressure. Details on request.

**Circle 490 on Page 19**

**METER-RELAYS**—Assembly Products, Inc. Catalog 4E describes API's meter-relays for any electrically-measurable variable. An essentially simple instrument, yet highly accurate and dependable.

**Circle 491 on Page 19**

**AUTOMATIC CONTROL EQUIPMENT**—Zenith Electric Company. Provides a full line of the most accurate and reliable timing devices available to industry. Complete line of Program Timers, Interval Timers, Explosion-Proof Timers, Automatic Reset Timers, and Process Timers. Bulletin describes complete line.

**Circle 492 on Page 19**

**PROXIMITY PICKUP**—Electro Products Laboratories. Electro detects ferrous and nonferrous metals. Pickups sealed against water and oil. Unaffected by nearby 60 cycle ac fields. Bulletin on request.

**Circle 493 on Page 19**

**MINIATURE TIME DELAY RELAY**—Elastic Stop Nut Corp. of America, A.G.A. Div. Agastat makes 24 models of Time Delay Relays with adjustable timing ranges from 0.030 to 120 seconds. Complete specs available.

**Circle 494 on Page 19**

**TIME-PROPORTIONING CONTROL**—Assembly Products, Inc. API meter-relay-actuated controller holds temperature accurately to within 1±F° of desired set point. Data sheet 9-B describes Simplytrol device.

**Circle 495 on Page 19**

**MAGNETIC CLUTCHES**—Fawick Corp., Airflex Div. Fawick Magnetic clutches provide fast, dependable response. Size ranges from 2¼" to 13¼" in diam; torque ratings from 27 inch-pounds to 66,000 inch-pounds. Bulletin M-102 on request.

**Circle 496 on Page 19**

**ELECTRIC SPEED VARIATOR**—General Electric offers a new, packaged, adjustable-speed drive—the Speed Variator. Offering wide speed ranges and good regulation, it can help your machines produce a greater variety of goods, faster and at lower cost per unit. Bulletin on request.

**Circle 497 on Page 19**

**AUTOMATION CONTROLS CATALOG**—General Controls Company. This catalog has a complete diversified line of controls for automation in a single usable format. Everything you need—program timers, actuators, automatic valves, sensing devices, potentiometers, and counters. Ask for your copy now.

**Circle 498 on Page 19**

**RELAYS**—General Dynamics Corp., Stromberg-Carlson Div. New relay catalog describes relays plus spring combinations, table of equivalents, contact data, variations, and special features, plus complete mounting and cover information.

**Circle 499 on Page 19**

**CYPAK CONTROL**—Westinghouse Electric Corp. When accuracy is a must and shutdowns cannot be tolerated, choose Westinghouse Cypak static control. No moving parts to weaken or wear . . . it never needs to be replaced. Saves time, gives perfect accuracy, and reduces maintenance. Full facts on request.

**Circle 500 on Page 19**

**AC SOLENOIDS**—West Coast Electrical Mfg. Corp. WesCo's famous Series 100, 200, and 400 AC Solenoids—75 models in all—are immediately available in small or large quantities. Complete catalog available.

**Circle 501 on Page 19**

**SWITCHES**—Hetherington, Inc. New HiPac Precision Switches . . . take on high current in control and indicating circuits. Switches are available with any of eight actuators. Complete specifications on request.

**Circle 502 on Page 19**

**MINIATURE SOLENOIDS**—Detroit Coil Co. Decco solenoids' unique engineering features and top quality materials have greatly extended their service life. Write for catalog.

**Circle 503 on Page 19**

**LIMIT SWITCHES**—R. B. Denison Mfg. Co. Catalog 956 describes single pole, double pole, multiple circuit, and neutral position switches. All models are water, dust, and oil tight at no extra cost.

**Circle 504 on Page 19**

**TIME DELAY RELAYS**—Clark Controller Co. Models with either 2 or 4 timed contacts and up to 6 instantaneous contacts available in Clark's type "PMT" time delay relays.

**Circle 505 on Page 19**

**THERMISTORS AND VARISTORS CATALOG**—Victory Engineering Corp. New technical catalog covers over 250 VECO stock items, and also has an educational series entitled "Meet The VECO Thermistor." Write for your copy today.

**Circle 506 on Page 19**

**PROXIMITY LIMIT SWITCH**—Westinghouse Electric Corp. New Limit Switch that won't wear out . . . never needs replacement. No tubes or moving parts to weaken and fail from wear. Waterproof, Explosionproof. Sensing heads available for distances of ½ inch and 2 inches. Details on request.

**Circle 507 on Page 19**

**LIQUID LEVEL CONTROLS**—Charles F. Warrick Co. Floatless Electrode Type Liquid Level Controls. No moving parts in the liquid . . . easy to install . . . no adjustments necessary . . . unaffected by acids or caustics . . . standard 2 & 3 pole units listed by U/L. 32-page catalog has all details.

**Circle 508 on Page 19**

**AUTOMATIC CIRCUIT CONTROL**—Counter & Control Corp. "Programonitor," low-cost automatic circuit control instantly recycles at high speed without skip or loss of count. Settings up to 4000 counts. Bulletin 505 gives details.

**Circle 509 on Page 19**

**TERMINAL BLOCKS**—Curtis Development and Manufacturing Co. Simplify your control wiring with Curtis Terminal blocks. Bulletins describe features of entire line.

**Circle 510 on Page 19**

**PRECISION SWITCHES**—Minneapolis-Honeywell, Micro Switch Div. Simple, inexpensive way to modernize existing equipment. Your own maintenance men can do it. Catalog 84 on request.

**Circle 511 on Page 19**

**AUTOMATIC RECYCLING CONTROL**—Counter and Control Corp. Bulletin 202-1 covers details of "Cyclo-Monitor." Replaces change gears, complicated cam systems, and timing chains.

**Circle 512 on Page 19**

**IN-LINE DIGITAL DISPLAY**—Industrial Electronic Engineers, Inc. Complete specifications available on new rear-projection-type in-line digital display. Easily viewed over 100' away.

**Circle 513 on Page 19**

**UNIVERSAL POLE RELAYS**—Clark Controller Co. Double the number of contacts per relay with Clark Universal Pole Relays. Up to 14 contacts per relay. Complete information available.

**Circle 514 on Page 19**

**CONVERTIBLE POLE RELAYS**—Clark Controller Co Sectional-pole or modular construction. Ten standard units with 2 to 12 poles, from 5 basic models. Individual poles front removal without disturbing wiring. Details available.

**Circle 515 on Page 19**

**SWITCHING REACTOR**—Magnetics, Inc., Control Div. Single control switching reactor replaces electronic relay, two small mechanical relays, a limit switch, and a separate power supply. Never wears out. 10,000 to one switching ratio. Ratings of 15, 75, 150, and 300 VA.

**Circle 516 on Page 19**

**MULTI-PURPOSE PRESSURE CONTROL**—Mercoid Corp. Three case styles of Mercoid controls are available: General Purpose, Weather Proof, and Explosion Proof. They provide external adjustments, repetitive trip point, and reset valve; visible calibrated dial and contact. Catalog 858 gives all specifications.

**Circle 517 on Page 19**

**LIGHTWEIGHT PRESSURE CONTROL**—Mercoid Corp. The Mercoid pressure control for mediums not injurious to steel or silver solder. External adjustment; Fairprene diaphragm pressure element. ¼" I.P.S. pressure connection; three-post terminal block internal wiring connections. Bulletin O2 on request.

**Circle 518 on Page 19**

**LIMIT SWITCHES**—Minneapolis-Honeywell, Micro-Switch Div. Long-life precision switching elements in sturdy sealed aluminum housings characterize the "ML" switch family. Adequate wiring space; #8 screw terminals; sealed covers secured with captive screws. Catalog 84 covers the entire line.

**Circle 519 on Page 19**

**RELAYS**—Universal Relay Corp. Largest stock of relays in the world. Production quantities . . . most makes in stock. Send now for latest Catalog A.

**Circle 520 on Page 19**

**PANEL-MOUNTED ELECTRICAL COUNTER**—Veeder-Root, Inc. Widely used for remote indication . . . can be grouped on panels in office. Speeds up to 1000 counts per minute. Knob or lock-key reset. 6 figures. Information available.

**Circle 521 on Page 19**

**RECTIFLOW DRIVE**—Westinghouse Electric Corp. New Westinghouse Rectiflow Drive . . . single, compact unit permits adjustable speeds direct from A-C power source. Available in constant hp or constant torque. Data on request.

**Circle 522 on Page 19**

**LATCH RELAYS**—Clark Controller Co. Extra poles, coils, magnet assemblies, and other components available in kit form—a time saver for maintenance men. 2 to 10 poles.

**Circle 523 on Page 19**

**MULTI-CIRCUIT CYCLE TIMER**—Zenith Electric Company. Multi-Circuit Cycle Timer insures long-lasting accuracy . . . trouble-free performance in timing, mixing, compounding, processing, and similar operations. Immediate delivery in any quantity. Bulletin on request.

**Circle 524 on Page 19**

**REPEAT CYCLE CONTROLLER**—Counter and Control Corp. "Acratrol" repeat cycle controller. Automatic, instantaneous recycling with no time lag. Bulletin 600 on request.

**Circle 525 on Page 19**

**MANUAL STARTER**—Clark Controller Co. Manual starter in size 0 and 1, nonreversing, reversing, and two-speed types, open and enclosed models. Bulletin 6002 CM gives the full story.

**Circle 526 on Page 19**

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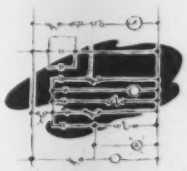


## Electrical Systems

**CONTROL CENTERS**—Westinghouse Electric Corp. Westinghouse Control Centers feature dual-modular units to solve your space problems. Steel or aluminum control centers that house a complete range of devices to meet specialized control requirements. Complete information available.

**Circle 527 on Page 19**

**LOAD-A-MATIC CRANE SYSTEM**—Westinghouse Electric Corp. Heavy-duty, precision a-c crane system built to industry standards. Highly favored for applications that call for unusual stamina, ease of operation, and low-maintenance cost. Complete data on request.

**Circle 528 on Page 19**

**ANALOG-DIGITAL CONVERTERS**—Librascope, Inc. Subsidiary of General Precision Equipment Corp. Packaged units for conversion of shaft position-to-digital code for computers and data handling systems. Complete specifications available in Catalog E10-1.

**Circle 529 on Page 19**

**TEMPERATURE CONTROL**—Westinghouse Electric Corp. New Westinghouse Limitemp. Medium-priced control device that is ideal for monitoring or controlling temperatures between 100° F and 400° F. No vacuum tubes, no moving parts. Write today for full details.

**Circle 530 on Page 19**

**ELECTRICAL ENCLOSURES**—Hoffman Engineering Corp. Hoffman oil-tight, dust-tight electrical enclosures available in 18 stock sizes for wall mounting; 12 sizes for panel enclosures and 8 stock sizes for jig wiring boxes. Pushbutton enclosures for 1 to 25 pushbuttons. Enclosures also built to customer specifications.

**Circle 531 on Page 19**

**LOAD SWITCH**—JIC Electric Co. Four standard models. No vacuum tubes. Safeguards equipment by automatically ringing alarm bell, starting, stopping, or reversing a motor.

**Circle 532 on Page 19**

**SQUARE ROOT INTEGRATOR**—Librascope, Inc., Subsidiary of General Precision Equipment Corp. New Square Root Integrator designed to provide an economical, continuous, and compact integrator for the automatic totalization of flow. Write for Catalog 10M-1.

**Circle 533 on Page 19**

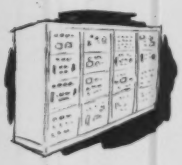
**STATIC AMPLIFIER**—Westinghouse Electric Corp. New Westinghouse Bistable Amplifier combines magnetic and tran-

sistor circuitry for an input sensitivity of 5 x $10^{-8}$ watts a-c or d-c. Output power is 6 watts at 24 volts d-c. Further facts on request.

Circle 534 on Page 19

**LINEAR POSITIONING SYSTEM**—Westinghouse Electric Corp. Unaffected by wear and free from backlash, NULTRAX linear positioning system makes possible the measurement of linear displacement on one or more axes to accuracies of one hundred thousandth of its full range of travel, which may extend over distances of many feet. Complete data on request.

Circle 535 on Page 19



## Electronic Controls

**ADJUSTABLE-SPEED DRIVES**—Servo-Tek Products Co. Infinitely adjustable from less than 36 rpm to more than 3600 rpm while delivering full rated torque. Full details available.

Circle 536 on Page 19

**PRODUCTION CONTROL INSTRUMENTS**—Photomation Inc. Indicators, recorders, controls, and electric-eyes. Each ESS instrument is designed to do a specific job for industry—monitoring smoke, turbidity, dusts, gases, color, combustion, or general production control.

Circle 537 on Page 19

**PHOTO-ELECTRIC CONTROL**—Standard Instrument Corp. Robot-eye, versatile, miniaturized, low-cost photo-electric control is described completely in Brochure LP-5. Counts, sorts, inspects.

Circle 538 on Page 19

**COUNTERS**—Veeder-Root, Inc. All types of counters . . . manual, mechanical, electromagnetic, electronic . . . to count anything at any speed. Full data available.

Circle 539 on Page 19

**MEASURING SYSTEMS**—Post Machinery Co. The Post LF-IA Lineal Footage System combines the accuracy of proven electronic equipment with a visual "Clary" readant. Ideal for accurate measurement for manufacturers of wire, paper, textiles, and sheet metal. Literature on request.

Circle 540 on Page 19

**TEMPERATURE CONTROL**—Minneapolis-Honeywell. First transistorized device for precise industrial temperature control—Versa-Tran. Extremely versatile. Designed around transistors and printed circuitry. Thermistor sensors available for air stream, wall, or surface mounting. Controls temperatures between 60° and 500° F.

Circle 541 on Page 19

**ELECTRONIC DEVICES**—General Electric. New G-E Photoelectric Control Catalog GEA-6922 offers complete description, specifications, and pricing data on the complete line. Full line of simple, easy-to-use controls. Write now for full details and specifications.

Circle 542 on Page 19

**ELECTRONIC COUNTING TUBES**—Baird-Atomic, Inc Dekatron counting tubes for reliable, high speed counting applications. Reliable performance on all high speed counting operations. Data sheet available.

Circle 543 on Page 19

**UNIVERSAL RECORDER**—The Hays Corporation. A truly universal recorder that provides continuous record of four variables on one chart; plus, in many cases, an additional integrator, pneumatic controller, or transmitter. Further information on request.

Circle 544 on Page 19

**PHOTOELECTRIC CONTROLS**—Autotron, Inc. New catalog shows wide selection of modern industrial photoelectric and other electronic controls. Application diagrams included.

Circle 545 on Page 19

**FAST COAXIAL DISCONNECT**—AMP Inc. Eliminate soldering with new coaxial disconnect technique-coaxicon. Two strokes of A-MP precision tool does it. Complete information available.

Circle 546 on Page 19

**ELECTRONIC SUPPLY GUIDE**—Allied Radio offers their complete 452-page catalog—your buying guide to the world's largest stocks of electronic supplies for industry.

Circle 547 on Page 19

**PRINTED CIRCUITS**—AMP Inc. offers a new printed circuit applications catalog. Single and multiple connector units, board-edger face attachments, solder dipping, eyeletting, and other topics are covered in this booklet.

Circle 548 on Page 19

**ELECTRON TUBES**—Radio Corp. of America, Electron Tube Div. Handy data book RIT-104-A gives tube characteristics for RCA "Premium" and "Special Red" tubes. Designed and built to give dependable performance under conditions of shock and vibration.

Circle 549 on Page 19

## Numerical Controls

**DIGITAL TAPE SPLICER**—Prestoseal Mfg. Corp. Presto-Splicer splices all 5 to 8 channel paper tapes as well as all ½" to 1¼" Mylar or acetate base magnetic tapes per-

fectly in two seconds. Buttweld or overlap splices. Tape maintains original condition after splicing. Illustrated brochure.

**Circle 550 on Page 19**

**PRINTED CIRCUIT BOARDS**—General Dynamics Corp., Stromberg-Carlson Div. Stromberg-Carlson gives "telephone quality" in printed circuit boards. They print and etch one or two sides, provide eyelets or terminals, and can provide gold plating where desired.

**Circle 551 on Page 19**

**MAGNETIC TAPE CONTROL**—Ampex Corp., Ampex Instrument Div. The Ampex digital tape handler can spew out alpha-numeric characters at rates as high as 30,000 to 90,000 per second. Tape can be erased and re-recorded. Application information available.

**Circle 552 on Page 19**

**NUMERICAL CONTROLS**—General Electric offers a Mark Series of numerical controls. Standard, job-proved packages now in use on a wide variety of machines. Systems control 1 to 5 motions plus machine auxiliary functions. Components of package are a controller, a punched tape reader, operator's control station, servo drives, and position-sensing units.

**Circle 553 on Page 19**

**FIBRE CONTROL TAPE**—National Vulcanized Fibre Co. "Peerless" fibre control tape gives more cycles per dollar than with any other tape material. Special cellulose plastic tape combines toughness, high tensile and bending strength with flexibility. Thicknesses: .0043 and .005". Colors: Red, Gray, and Blue in any width.

**Circle 554 on Page 19**

**OPERATIONS MONITOR**—Brush Instruments, Div. of Clevite Corp. Operations Monitor can improve the control of power distribution systems, chemical processes, and automated production lines. Moving chart is only 12" wide, can record 100 separate operations at the same time. Further details available.

**Circle 555 on Page 19**

**PUNCHED TAPE BLOCK READER**—Wang Laboratories, Inc. A versatile input device for numerically controlled systems. Standard 1 inch 5, 6, 7, or 8 levels, paper or Mylar. Up to 30 lines per reading (240 bits). Full facts available.

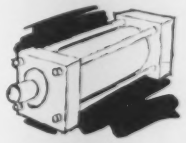
**Circle 556 on Page 19**

**DUAL TRACK RECORDING**—Micro-Path Inc. Micro-Path is the low-cost automation system recording programs directly without use of expensive computers or highly trained technicians. "Micro-Path Story" booklet just out.

**Circle 557 on Page 19**

**NUMERICAL POSITIONING CONTROL**—Wang Laboratories, Inc. A reliable, versatile, tape-controlled positioning system for both new and existing machinery. Simple (no electron tubes), inexpensive, and easy to maintain. Write today.

**Circle 558 on Page 19**



## Hydraulic Control

**HYDRAULIC VALVES**—Rivett, Inc. Easy-to-use valve Catalog 210 puts complete information on performance, ratings, dimensions, mounting and ordering instructions at your fingertips.

**Circle 559 on Page 19**

**HYDRAULIC PUMPS & VALVES**—General Metals Corp., Adel Precision Products Div., offers complete engineering specifications for control valves and gear-type hydraulic pumps with capacities from ¼ to 35 gpm at pressures to 1500 psi and speeds to 3600 rpm.

**Circle 560 on Page 19**

**AIR CYLINDERS**—Logansport Machine Co. Logan Supermatic cylinders are made to interchange with other leading manufacturer's cylinders. Logan designs assure the service required for those extra-rugged applications. Get your copy of Logan's Calculator & descriptive literature.

**Circle 561 on Page 19**

**CYLINDERS**—Oil-Dyne Inc. Precision-built cylinders, with bore sizes as small as ½", do the same work as larger bore size cylinders. Rated at 5000 psi; ½" to 4" bore sizes; stroke lengths up to 72". New catalog on request.

**Circle 562 on Page 19**

**PRESSURE SWITCHES**—Oil-Dyne Inc. Oil-Dyne pressure switches have a completely new design that eliminates all contact between O-ring and cylinder walls and combines to keep piston from sticking. 5-5000 psi, explosion proof. Single and duplex models. Illustrated brochure available.

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**SOLENOID VALVES**—General Controls Company. Four basic types of valves. Direct Acting solenoid valve . . . Lever Acting valve for high pressure liquid lines . . . Piloted Piston valve for high pressure and high flow . . . Diaphragm valve. Full information on request.

**Circle 564 on Page 19**

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**HYDRAULIC CYLINDERS**—Ortman-Miller Machine Co. Bulletin 105 gives all particulars on the O-M heavy-duty series TH Hydraulic (Oil) Cylinders. 2000 psi operation—3000 psi non-shock. 1½" to 8" bores. Complete selection of mountings.

Circle 565 on Page 19

**CYLINDERS**—Tomkins-Johnson. New SQUAIR Head Cylinder that is interchangeable with all standard JIC cylinders. Available in bore diameters from 1½" to 8". Produces maximum force and efficiency with minimum pressures. Write now for Bulletin SQ 10-58 and complete details.

Circle 566 on Page 19

**PUMPS**—Oil-Dyne Inc. Miniaturized in everything but power, Oil-Dyne pumps make hydraulic actuations possible on applications never before feasible. Built-in directional controls. Pressures to 3000 lbs. Illustrated catalog available.

Circle 567 on Page 19

**VARIABLE DISPLACEMENT PUMP**—Oilgear Co. Single, one-piece alloy steel, multiple radial rolling pistons. One-piece cylinder and shaft. Integral, adjustable volume control. Bulletin 47550 gives complete data on "Power-Saver" pumpline.

Circle 568 on Page 19

**CLOSE DIFFERENTIAL RELAYS**—Automatic Switch Co. ASCO close-differential relays protect motors from burnout when running on low voltage for an extended period of time. Catalog 57-S4 gives details.

Circle 569 on Page 19

**HYDRAULIC POWER CHECK**—Appco Corp. For smooth precise feed control of air cylinders and machines, Appco self-contained power check prevents chatter—unaffected by variations in power thrust. Detailed literature available.

Circle 570 on Page 19

**TWO-WAY SHUT-OFF COUPLING**—The Hansen Manufacturing Co. Available with female pipe thread connections from ⅛" to 1" inclusive. In brass or steel. Shuts off both sides of line . . . prevents loss of liquid, gas, or pressure. Information available.

Circle 571 on Page 19

**SOLENOID VALVES**—Airmatic Valve, Inc. Airmatic corrosion-proof valves have only one interval moving part. Coils are fully sealed, will not overheat, and are interchangeable. New catalog describes 3-way valve specifications.

Circle 572 on Page 19

**HYDRAULIC REMOTE CONTROLS**—General Metals Corp., Adel Precision Products Div., Adel Hydraulic Remote Controls provide sensitive, instant finger-tip operation of machinery of many types. Complete information available.

Circle 573 on Page 19

**CONTROL VALVES**—Auto-Ponents Inc., Pneu-Trol Div. Constant cylinder speed control with Pneu-Trol valves. Valve bodies machined from hex brass or aluminum for 2000 psi working pressures; steel and stainless steel for 5000 psi. Five female pipe sizes ⅛" to ¾". Illustrated circular on request.

Circle 574 on Page 19

**ELECTRO-HYDRAULIC SERVO VALVE**—Vickers Incorporated, Div. of Sperry Rand Corp. Electro-Hydraulic Servo Valve integrated with piston type hydraulic motor provides a minimum amount of oil under compression. Integral cross line relief valves are provided as well as variable cross line orifice for controlling viscous damping. This "package" can provide approximately 20 hp @ 3000 psi and 3600 rpm; variable speed of motor is 0-4400 rpm. Bulletin available.

Circle 575 on Page 19

**AIR & HYDRAULIC CYLINDERS**—S-P Mfg. Corp. Catalog 115 covers the S-P line of air and hydraulic cylinders rated 200 psi air or 1000 per hydraulic-water changeable air or hydraulic without modification. 23 mounting types.

Circle 576 on Page 19

**CONTROL VALVES**—Hunt Valve Company. Positive and fast-acting valves are designed and built to seal tightly, preventing leaks and minimizing the danger of breakdowns and tie-ups. Sizes from ⅛" to 8". Full specifications on request.

Circle 577 on Page 19

**SQUAREHEAD CYLINDERS**—Teer-Wickwire & Co., Lindberg Air & Hydraulic Div. Quick change rod cartridge, chrome plated steel piston rod, "No-Blo" head to tube sealing, one piece aluminum piston. Choice of mounting styles. Seven bore sizes to 6". Bulletin S-101 for further details.

Circle 578 on Page 19

**AIR POWERED AUTOMATION**—Mead Specialties Co. Work Feeder, with Meadmatic Timer and Drill Press Feed, transforms an ordinary drill press into an automatic machine to drill twin holes in chain saw links. Illustrated booklet gives 44 "Examples in Air Power Automation."

Circle 579 on Page 19

**AIR & HYDRAULIC CYLINDERS**—Valvair, Div. of International Basic Economy Corp. Heavy-Duty air and hydraulic cylinders offer performance, durability, and ease of maintenance. Built to JIC Standards and offering a full range of bore and rod sizes, stroke lengths, and cushioning options. Bulletin VC-800 gives full details.

Circle 580 on Page 19

**CIRCUIT RIDER**—Logansport Machine Co. Fifth edition of a 32-page manual on fluid power circuits has been completely revised to present current engineering trends.

Circle 581 on Page 19

**HYDRAULIC CYLINDER**—Lynair, Inc. Ten mounting styles of hydraulic cylinders available. 1½" to 10" bores. Conform to JIC hydraulic standards.

Circle 582 on Page 19

**SOLENOID VALVES**—Magnatrol Valve Corp. Eliminate costly flow failures with Magnatrol solenoid valves. Quick operating, non-sticking, and tight seating. Pressure ranges from 0 to 300 psi. Voltages to 575. Catalog on request.

Circle 583 on Page 19

AUTOMATION

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*The Magazine of Automatic Manufacturing Operations*

**These Companies Offer Products, Equipment, Services, for Use in Automatic Production**

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These suppliers have advertised their facilities in AUTOMATION during the twelve-month period October, 1958 through September, 1959.

To get specific information about the products these companies sell, look up the company name in the alphabetical index on pages 17 and 18. The item numbers listed after the company name are cross-reference guides to descriptions of products the manufacturer offers. Circle the numbers of those items which interest you on the Inquiry Card, page 19, then mail the card.

The supplier will answer you directly.

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| 418 | 448 | 478 | 508 | 538 | 568 | 598 | 628 | 658 | 688 | 718 | 748 | 778 | 808 |
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| 409 | 439 | 469 | 499 | 529 | 559 | 589 | 619 | 649 | 679 | 709 | 739 | 769 | 799 |
| 410 | 440 | 470 | 500 | 530 | 560 | 590 | 620 | 650 | 680 | 710 | 740 | 770 | 800 |
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| 414 | 444 | 474 | 504 | 534 | 564 | 594 | 624 | 654 | 684 | 714 | 744 | 774 | 804 |
| 415 | 445 | 475 | 505 | 535 | 565 | 595 | 625 | 655 | 685 | 715 | 745 | 775 | 805 |
| 416 | 446 | 476 | 506 | 536 | 566 | 596 | 626 | 656 | 686 | 716 | 746 | 776 | 806 |
| 417 | 447 | 477 | 507 | 537 | 567 | 597 | 627 | 657 | 687 | 717 | 747 | 777 | 807 |
| 418 | 448 | 478 | 508 | 538 | 568 | 598 | 628 | 658 | 688 | 718 | 748 | 778 | 808 |
| 419 | 449 | 479 | 509 | 539 | 569 | 599 | 629 | 659 | 689 | 719 | 749 | 779 | 809 |
| 420 | 450 | 480 | 510 | 540 | 570 | 600 | 630 | 660 | 690 | 720 | 750 | 780 | 810 |
| 421 | 451 | 481 | 511 | 541 | 571 | 601 | 631 | 661 | 691 | 721 | 751 | 781 | 811 |
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| 423 | 453 | 483 | 513 | 543 | 573 | 603 | 633 | 663 | 693 | 723 | 753 | 783 | 813 |
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| 428 | 458 | 488 | 518 | 548 | 578 | 608 | 638 | 668 | 698 | 728 | 758 | 788 | 818 |
| 429 | 459 | 489 | 519 | 549 | 579 | 609 | 639 | 669 | 699 | 729 | 759 | 789 | 819 |
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**AUTOMATION** October 1959

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| 406 | 436 | 466 | 496 | 526 | 556 | 586 | 616 | 646 | 676 | 706 | 736 | 766 | 796 |
| 407 | 437 | 467 | 497 | 527 | 557 | 587 | 617 | 647 | 677 | 707 | 737 | 767 | 797 |
| 408 | 438 | 468 | 498 | 528 | 558 | 588 | 618 | 648 | 678 | 708 | 738 | 768 | 798 |
| 409 | 439 | 469 | 499 | 529 | 559 | 589 | 619 | 649 | 679 | 709 | 739 | 769 | 799 |
| 410 | 440 | 470 | 500 | 530 | 560 | 590 | 620 | 650 | 680 | 710 | 740 | 770 | 800 |
| 411 | 441 | 471 | 501 | 531 | 561 | 591 | 621 | 651 | 681 | 711 | 741 | 771 | 801 |
| 412 | 442 | 472 | 502 | 532 | 562 | 592 | 622 | 652 | 682 | 712 | 742 | 772 | 802 |
| 413 | 443 | 473 | 503 | 433 | 563 | 593 | 623 | 653 | 683 | 713 | 743 | 773 | 803 |
| 414 | 444 | 474 | 504 | 534 | 564 | 594 | 624 | 654 | 684 | 714 | 744 | 774 | 804 |
| 415 | 445 | 475 | 505 | 535 | 565 | 595 | 625 | 655 | 685 | 715 | 745 | 775 | 805 |
| 416 | 446 | 476 | 506 | 536 | 566 | 596 | 626 | 656 | 686 | 716 | 746 | 776 | 806 |
| 417 | 447 | 477 | 507 | 537 | 567 | 597 | 627 | 657 | 687 | 717 | 747 | 777 | 807 |
| 418 | 448 | 478 | 508 | 538 | 568 | 598 | 628 | 658 | 688 | 718 | 748 | 778 | 808 |
| 419 | 449 | 479 | 509 | 539 | 569 | 599 | 629 | 659 | 689 | 719 | 749 | 779 | 809 |
| 420 | 450 | 480 | 510 | 540 | 570 | 600 | 630 | 660 | 690 | 720 | 750 | 780 | 810 |
| 421 | 451 | 481 | 511 | 541 | 571 | 601 | 631 | 661 | 691 | 721 | 751 | 781 | 811 |
| 422 | 452 | 482 | 512 | 542 | 572 | 602 | 632 | 662 | 692 | 722 | 752 | 782 | 812 |
| 423 | 453 | 483 | 513 | 543 | 573 | 603 | 633 | 663 | 693 | 723 | 753 | 783 | 813 |
| 424 | 454 | 484 | 514 | 544 | 574 | 604 | 634 | 664 | 694 | 724 | 754 | 784 | 814 |
| 425 | 455 | 485 | 515 | 545 | 575 | 605 | 635 | 665 | 695 | 725 | 755 | 785 | 815 |
| 426 | 456 | 486 | 516 | 546 | 576 | 606 | 636 | 666 | 696 | 726 | 756 | 786 | 816 |
| 427 | 457 | 487 | 517 | 547 | 577 | 607 | 637 | 667 | 697 | 727 | 757 | 787 | 817 |
| 428 | 458 | 488 | 518 | 548 | 578 | 608 | 638 | 668 | 698 | 728 | 758 | 788 | 818 |
| 429 | 459 | 489 | 519 | 549 | 579 | 609 | 639 | 669 | 699 | 729 | 759 | 789 | 819 |
| 430 | 460 | 490 | 520 | 550 | 580 | 610 | 640 | 670 | 700 | 730 | 760 | 790 | 820 |

## ANNUAL PRODUCT REVIEW

**Circle item number for literature and further information on any product described in this issue**

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**FLUID POWER LINES**—Eastman Mfg. Co. Technical Bulletin 100 covers "Medium Pressure Hose and Tube Assemblies, Couplings and Fittings for One Wire Braid Hose." Tech. Bulletin 200 covers "Multiple Wire Braid Hose."

**Circle 584 on Page 19**

**HYDRAULIC CYLINDERS**—Flick-Reedy Corp., Miller Fluid Power Div. Sealed against external leakage with Teflon. Withstands temperatures from 100° F to plus 450° F. Case-hardened chrome plated piston rods, 3000-5000 psi, 1½" through 12" bores, 17 mounting styles. Strokes up to 22', cushioned and noncushioned.

**Circle 585 on Page 19**

**LIQUID LEVEL SIGHT GAGES**—Century-Detroit, Century-Hydraulic Div. New catalog of dimensional information on hydraulic reservoirs and power unit accessories available. Leak-proof sightgages can be used with non-inflammable oil.

**Circle 586 on Page 19**

**NEW "TRIM LINE" VALVES**—Hunt Valve Company. An unbelievably small valve with a long, long life. Priced economically. Available in 3-way and 4-way actions. Furnished tapped for either ⅛" or ¼" pipe connections. Designed for installations where space is limited. Write for further facts.

**Circle 587 on Page 19**

**SOLENOID VALVES**—Skinner Electric Valve Div. Skinner 3-way, high-flow solenoid valves in ⅜", ½", and ¾" orifice sizes. 5 to 150 psi operating pressures. Buna-N coated nylon diaphragm assembly assures long life.

**Circle 588 on Page 19**

**MANUAL VALVES**—Valvair, Div. of International Basic Economy Corp. Unlimited combinations using standard components. No need to endure complicated parts inventory, delivery delays, and the other headaches connected with special modifications of manual valves. Send now for your free Valvair manual valve selector.

**Circle 589 on Page 19**

**HYDRAULIC CYLINDERS**—Hanna Engineering Works. Hanna Powrdraulic hydraulic cylinders meet JIC recommendations and have industry standard mounting dimensions . . . 2000 psi and 3000 psi non-shock. 1½" through 8" bores. Many outstanding features. Write now for further facts.

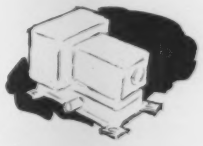
**Circle 590 on Page 19**

**TIME DELAY CONTROL SWITCH**—Auto-Ponents, Inc., Pneu-Trol Div. Holds any motion or operation controlled or actuated by air or hydraulic cylinders at a positive stop on either end of the stroke for ¼ to 60 seconds in 20 to 1 ratios. Available with five actuating lever linkages.

**Circle 591 on Page 19**

**HYDRAULIC CYLINDERS**—Hannifin Company, Div. of Parker-Hannifin Corp. Hannifin hydraulic cylinders proved best by drip-free test. Ground and polished rods hardened to an extra-deep case, then hard-chrome plated and polished again. 48-hour delivery on most cylinders whenever required. Literature on request.

**Circle 592 on Page 19**



## Pneumatic Control

**SPEED CONTROL VALVES**—Ross Operating Valve Co. Tranquilize your cylinders with Ross speed control valves. Three adjustable head styles (knob, pin, or slot) available. Aluminum alloy body. Bubble-tight poppet. Pip sizes ¼" to 1¼".

**Circle 593 on Page 19**

**T-J SPACEMAKER CYLINDERS**—Tomkins-Johnson. T-J Spacemaker cylinders last longer, have more efficient cylinder service. Wide range of styles and capacities, with 64,000 combinations. Bulletin SM 155-3 has complete engineering details.

**Circle 594 on Page 19**

**MANIFOLDS**—Valvair, Div. of International Basic Economy Corp. Simplify piping . . . cut installation and maintenace costs . . . sizes and types for every application. Easy unit replacement speeds in-service maintenance. Manifold sizes range from ¼ to 1 inch NPT. Additional data available.

**Circle 595 on Page 19**

**AIR POWERED BRAKING SYSTEMS**—Wagner Electric Company. Air powered braking systems that offer unusual flexibility of application since any number of brakes and control points may be used at any reasonable distance from each other. Write for full specifications.

**Circle 596 on Page 19**

**HOSE & TUBE FITTINGS**—The Weatherhead Company. Here's a single source supplier of all industrial hose and fittings needs. You're assured of good service, quality products, and dependability in all products. Booklet has specifications on all lines.

**Circle 597 on Page 19**

**CAM VALVES**—Ross Operating Valve Co. Cam valves are the key to air automation. They can act on almost any mechanical signal to set off or restrict another operation. Booklet available on many models.

**Circle 598 on Page 19**

**FREE INFORMATION & LITERATURE**

For more information about any product or useful literature mentioned in this issue, simply circle the item numbers on the Inquiry Card on page 19. Fill out and drop the postage free card in the mail today.

**SUMP OIL FILTER**—Air-Maze Corp. New sump oil filter for hydraulic and lube oil systems is written up in specification sheet OCO 1057. Capacities from 1 to 100 gpm, male or female connection. Wide choice of bronze, monel, or stainless media provides various degrees of positive filtration.

**Circle 599 on Page 19**

**UNIVERSAL PILOT**—Vailvair, Div. of International Basic Economy Corp. Valvair's one Universal Pilot . . . completely interchangeable on all Speed Kin valves . . . has only two moving parts. Peak performance . . . unmatched reliability . . . minimum parts inventory. Write today for Bulletin D-58.

**Circle 600 on Page 19**

**FILTERS, REGULATORS, LUBRICATORS**—Watts Regulator Company. You can expect high efficiency from the Watts line of advanced-design air line filters, regulators, and "Perma-Fog" lubricators. Specialists in protection and control devices since 1875. New catalog describes entire line.

**Circle 601 on Page 19**

**AIR CYLINDER CATALOG**—A. K. Allen Co. offers a new 47-page illustrated catalog on air cylinders, valves, clamps, and dial feed tables.

**Circle 602 on Page 19**

**SQUARE-END CYLINDERS**—Scovill Mfg. Co., A. Schrader's Son Div. Five sizes up to 4" bore and with five interchangeable mountings—bolt, leg, flush, sideflush, or base. Air pressure to 250 psi, or hydraulically to 750 psi—available cushioned or non-cushioned. Complete specifications on request.

**Circle 603 on Page 19**

**TIME DELAY SWITCH**—Auto-Ponents Inc. For controlled time dwell of air or hydraulic cylinders, Pneu-Trol automatic time delay switches stop on either end of the stroke for 1/4 to 60 seconds in 20 to 1 ratios. Automatically reset after each actuation. Available with many thrust linkages for left and right, down, up, or horizontal thrust. Bulletin TDS-59 on request.

**Circle 604 on Page 19**

**AIR & HYDRAULIC ACTUATORS & CONTROLS**—Wagner Electric Company. For specific applications, Wagner can furnish engineered kits with actuators, controls, tubing, fittings—everything required for complete installation. Detailed data on request.

**Circle 605 on Page 19**

**AIR EXHAUST SILENCER**—Air-Maze Corp. High noise levels are effectively reduced by new silencer. Fits directly to exhaust supports or piping. Bulletin KK-657 gives complete information.

**Circle 606 on Page 19**

**AIR CYLINDERS EXPLAINED**—Allenair Corp. offers a new catalog explaining the construction of modern air cylinders.

**Circle 607 on Page 19**

**SMALL AIR VALVES**—Numatics, Inc. New SA Junior Series air valves offered in many model varieties—three different sub-plates—three operator options and four styles at manifolds to provide application versatility unlimited. Catalog SAJ-59 tells the complete story.

**Circle 608 on Page 19**

**ROUND-LINE CYLINDERS**—Ortman Miller Machine Co. Available in complete range of sizes (1 1/2" to 8" bores) with standard 2 to 1 or reverse rods. Catalog 101A describes all details of this round-line of cylinders.

**Circle 609 on Page 19**

**AIR CIRCUITRY**—Westinghouse Air Brake Company, Industrial Products Div. Interesting booklet available on a new concept for air control. A comprehensive discussion of the 4 basic principles involved in designing an economical "control by air" system for industrial machines and processes. Send for your free copy today.

**Circle 610 on Page 19**

**QUICK RELEASE VALVE**—Westinghouse Air Brake Company, Industrial Products Div. New quick release valve that is lightweight, flexible mounting and has more sensitive control, speeds the operation of any pneumatic circuit. Complete information available.

**Circle 611 on Page 19**

**FLOREG VALVES**—Westinghouse Air Brake Company, Industrial Products Div. New FLOREG valves for accurate flow control of gases and liquids. Operating temperature range: 40° to 200° F. Three sizes: 1/4", 3/8", and 1/2", N. P. T. Information on request.

**Circle 612 on Page 19**

**FILTER DISC**—Air-Maze Corp. New, completely self-contained, filter disc provides simple adaptation to any product design. Filter media is multiple layers of fine mesh steel or bronze wire screen. Complete details available.

**Circle 613 on Page 19**

**VALVES**—Humphrey Products Div. The basic "Quick-Dump" valve, small in size, large in capacity, and lightning-fast in operation, permits endless variations in body type, methods of mounting, and methods of actuating. There are round, square, and cartridge styles. Full specifications on request.

**Circle 614 on Page 19**

**AIR CYLINDER**—Lynair, Inc. Eleven mounting styles of air cylinders available. 1 1/2" to 10" bores. Steel leads, shells, piston rods, and tie rods. Piston rod and shell hard chrome plated.

**Circle 615 on Page 19**

**MANUAL-LECTRIC VALVE**—Barksdale Valves, Control Valve Division. New valve can be actuated by hand, whether the coil is energized or de-energized. Normally solenoid pilot operated. Prices and catalog available.

**Circle 616 on Page 19**

**CYLINDER SPEED CONTROL**—Auto-Ponents Inc. Pneu-Trol valves combine compact body with fine thread needle for accurate air or oil flow control. Five female pipe sizes—1/8" to 3/4". Illustrated circular lists full specifications.

**Circle 617 on Page 19**

**VALVES**—Hanna Engineering Works. Complete line of air and hydraulic valves. Furnish economical power for thousands of jobs. Priced right, built to last longer. Details on request.

**Circle 618 on Page 19**

**SLIM-LINE BULLETIN**—Hunt Valve Company. Bulletin No. 581 describes complete line of valves. Now available with 8 types of operators. 3-way and 4-way actions. Easily manifolded into compact control centers. Write now for your copy.

**Circle 619 on Page 19**

**BREATHER FILTER**—Air-Maze Corp. breather filters keep dust out of engine and compressor crankcases, gearcases, hydraulic equipment, and machinery. Oil-wetted and oil-bath models available in sizes from 1/8" to 3 1/2". Booklet BC-453 gives complete story.

**Circle 620 on Page 19**

**CLAMPS**—Lapeer Mfg. Co. Knu-Vise "cam action" type clamps hold work rigidly to keep quality high and reduce rejects. More than 150 types of clamps and pliers to do almost any holding job. Made to last. Hand or air operated.

**Circle 621 on Page 19**

**AIR VALVES**—Barksdale Valves, Control Valve Division. Air valves for the nerve centers of production. 250 psi four-way air valves in 1/4", 3/8", and 1/2" pipe sizes. Bulletin includes all design specs.

**Circle 622 on Page 19**

**AIR POWER UNITS**—Hannifin Company, Div. of Parker-Hannifin Corp. Anywhere you use compressed air to do work, Hannifin can help you. Hannifin cylinders for the "muscles" . . . Hannifin air valves for any type of actuation, hand, foot, cam, solenoid, or pressure . . . the Hannifin "Crown" line of filters, regulators, and lubricators for lasting air power efficiency. Data on request.

**Circle 623 on Page 19**

**COUPLINGS CATALOG**—The Hansen Manufacturing Company. A ready reference when you want information on couplings in a hurry. Lists complete range of sizes and types of Hansen Quick-Connective Couplings, One-Way Shut-Off, Two-Way Shut-Off, and Straight-Through Couplings. Write today for your copy.

**Circle 624 on Page 19**

**AIRLINE BOOSTER PUMP**—Lynair, Inc. Lynair's Airline Booster was developed to boost airline pressure automatically in surge tanks or die cushions. Booster furnished in ratios of 1.5 to 1 up to 6.25 to 1. Completely valved. Just three pipe connections to be made.

**Circle 625 on Page 19**

**CIRCULAR-FLOW AIR VALVE**—Mechanical Air Controls, Inc. MAC's Dual-Spool air valves operate at speeds that meet any known requirement with shorter stroke, direct operation, and a highly efficient circular air flow that provides full flow throughout rated capacities. Available in 1/2", 3/4", 1", and 1 1/4" pipe sizes.

**Circle 626 on Page 19**

**AIR LINE PROTECTION**—M-B Products. M-B Whirl-a-way filter regulator and lubricator assembly and automatic air trap used for protection of air valves, cylinders, controls, pneumatic tools, etc. Automatic eliminates manual draining.

**Circle 627 on Page 19**

**MULTIPLE NUT SETTERS**—Gardner-Denver Company. Speed production, control torque with air-powered multiple nut setters. All components are specifically designed for fast, accurate multiple nut running. Unit can speed the job . . . cut time and costs. Information available.

**Circle 628 on Page 19**

**SPOT-A-MATION**—The Bellows Company, Div. of International Basic Economy Corporation. A Spot-A-Mation idea file contains installation data, wiring diagrams, and equipment lists for scores of "Controlled-Air-Power" applications. You can automate existing machines or build your own low-cost special-purpose equipment.

**Circle 629 on Page 19**

**AIR MOTOR-HYDRO-CHECK UNIT**—The Bellows Company, Div. of International Basic Economy Corporation. Compact, complete, packaged unit that is simple to install. Available in standard stroke lengths up to 18" and in five bore sizes: 1 1/4", 1 3/4", 2 1/2", 3 5/8", and 4 1/2". Bulletin contains full story.

**Circle 630 on Page 19**

**APPLICATION IDEAS BULLETIN**—Gast Rotary. New Gast booklet gives you "Application Ideas" on uses of air motors, compressors, and vacuum pumps. Line drawings show dozens of the basic principles of putting air to work. Write for full details.

**Circle 631 on Page 19**

**VIH CYLINDERS**—Modernair Corp. Performance-proved air cylinders with built-in directional and exhaust speed control valves. Interchangeable mountings; single conduit connection. Requires 10 watts of solenoid power. Complete data bulletin.

**Circle 632 on Page 19**

**SOLENOID VALVES**—Automatic Switch Co. Catalog 202 covers ASCO line of solenoid valves operating up to 400 cycles per minute. Available in 3/8", 1/2", and 3/4" sizes.

**Circle 633 on Page 19**

**AIR MINIATURES**—Clippard Instrument Laboratory. Bulletin MA miniature air cylinders, 4-way air valves, quick connects, etc. Life tested for millions of cycles of trouble-free operation.

**Circle 634 on Page 19**

**FREE INFORMATION & LITERATURE**

For more information about any product or useful literature mentioned in this issue, simply circle the item numbers on the Inquiry Card on page 19. Fill out and drop the postage free card in the mail today.

**WORK FEEDERS**—The Bellows Company, Div. of International Basic Economy Inc. Electrically controlled, rotary or linear work feeders are easily installed, readily synchronized with any machine cycle. Automatically positions work pieces for your drilling, tapping, reaming, milling, pressing, and welding operations. Full specification and application data available.

Circle 635 on Page 19

**AIR MOTORS**—Gardner-Denver Company. Bulletin No. 70 describes Axial Piston Air Motors, 0.6 to 2.7 hp. Bulletin No. AM-1 describes Five-Cylinder Radial Air Motors, 3 to 16 hp. Bulletin No. 71-21 illustrates Rotary Vane Air Motors to 1.6 hp.

Circle 636 on Page 19

**AIR VALVE SOLENOIDS**—Clippard Instrument Laboratory. For big jobs in small places, new "Minimatics," mighty miniature air valve solenoids and valves. Write for Bulletin No. 4-59.

Circle 637 on Page 19

**MULTIPLE DRILLING MACHINE**—Gardner-Denver Company. Standard Model 92-2P "Airfeedrills" has ten permanently mounted drills on the fixture. Five "Airfeedrills" are vertically mounted on a reciprocating slide to facilitate loading and unloading the part. Here's a real solution to your tough production problems. Complete information on request.

Circle 638 on Page 19

**DIRECTIONAL CONTROL VALVES**—The Beckett-Harcum Company. Hi-Cyclic Valve provides extremely compact multiple valve installation with common subplate for automation controls on specialized machine tools and other production equipment. Full details on request.

Circle 639 on Page 19

**AIR MOTOR**—The Bellows Company, Div. of International Basic Economy Inc. Versatile air cylinder provides sure, positive control. Choice of built-in valves gives control flexibility. Single air connection simplifies installation. Booklet offers additional data.

Circle 640 on Page 19

## Instrument and Process Control

**DIGITAL READOUT**—B & H Instrument Company, Inc. offers a Milli-V-Meter, the instrument with the tape-slidewire for flow, pressure, level, temperature, etc. Accuracy to 0.1%. Every scale division is a calibrated point with 100 calibrated points per foot of slidewire length. Linear, parabolic, logarithmic functions are displayed in direct digital relation. Information on request.

Circle 641 on Page 19

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**INDICATING CONTROLLERS**—Foxboro Co. Pneumatic controller offers sharp, fast on-off action, or smooth proportional control action easily adjustable up to 50%. Free from backlash, lost motion, and friction. Write for Bulletin 5A-13A.

Circle 642 on Page 19

**RECORDERS**—Barber-Colman Company. Wheelco potentiometer recorder controllers—whether circular or strip chart—have features you want right now. These advanced design recorders offer: Constant voltage source . . . quick range change . . . plug-in components . . . accessibility.

Circle 643 on Page 19

**INDICATING TEMPERATURE TRANSMITTER**—Foxboro Co. Uses any filled thermal system. Compact and lightweight, its indicating scale and fluorescent red pointer are visible up to 20 feet away. Bulletin 456 20A has details.

Circle 644 on Page 19

**PROGRAM CONTROLLERS**—West Instrument Corporation. Now compact, dependable, economical, guaranteed. Completely Automatic Process Control of Time-Temperature Cycle . . . through off-on or proportioning, high limit or stepless control action with secondary switching provisions. Data available on complete line.

Circle 645 on Page 19

**RECORDERS**—West Instrument Corp. Boost volume, assure quality and control costs with Marksman Tubeless Strip-Chart Potentiometer Recorders. Accurate within 1/5th of 1%. Data on request.

Circle 646 on Page 19

**MINIATURE VALVES**—George W. Dahl Co. Packless "Demi G" valves are miniature in size, weight, and price. Catalog D-1 gives all technical data.

Circle 647 on Page 19

**TEMPERATURE MONITORING**—Thomas A. Edison Industries, Instrument Div. Publication 3036-C describes the Edison Omniguard system of plug-in detector units for flexible temperature monitoring of oil, gas, and petrochemicals.

Circle 648 on Page 19

**3-FUNCTION CONTROLLERS**—Barber-Colman Company. For the solution of your control problems Wheelco Instruments offers 3-function control forms with low-cost 400 Series controllers. Here is outstanding process control accuracy at minimum cost. Details on request.

Circle 649 on Page 19

**FLOW TOTALIZING**—Foxboro Co. All-pneumatic Flyball Integrator completely eliminates intermittent counting and fire hazard. Complete details on request.

Circle 650 on Page 19

## Weight Control

**AUTOMATIC WEIGHING EQUIPMENT**—Richardson Scale Co. Select-O-Weigh systems governs all components required for automatic formulation by weight of any product, liquid or solid, involving any number of ingredients. Full details on request.

**Circle 651 on Page 19**

**LOAD CELL WEIGHING**—Howe Scale Co. Howetronic system for modern accurate loadcell weighing. Matched components guarantee all the advantages you should get from a load cell system. High cell output insures stable performance. Detailed information on request.

**Circle 652 on Page 19**

**AUTOWEIGHTION SYSTEMS**—Thayer Scale Corp. AUTO-WEIGHTION Systems for filling, batching and checkweighing. Working in conjunction with straight electrical controls, it forms the most reliable, low maintenance system ever devised to control processing or materials handling by weight. Literature on request.

**Circle 653 on Page 19**

**AUTOMATIC WEIGHING**—Merrick Scale Mfg. Company. "Feedaweight" for automatic feeding, blending, and proportioning of bulk material by weight. Utilizes a powered feed regulator controlled by the scale beam to increase or diminish the flow of material. Bulletins describe operation and application.

**Circle 654 on Page 19**

**WEIGHER-FEEDER**—Weighing and Control Components, Inc. Unitized construction makes the W-C Weigher-Feeder readily adaptable to practically any processing setup. Building-block design gives custom-made utility at an off-the-shelf cost. Send for Catalog 12.

**Circle 655 on Page 19**

**PLATFORM SCALE**—Weighing and Control Components, Inc. Eccentric loading, side thrusts, pile-ups won't affect the accuracy of the W-C Uni-Force Platform Scale. Details on request.

**Circle 656 on Page 19**

**HOPPER SCALE**—Weighing and Control Components, Inc. Standardized components adapt it to a full range of material handling methods, control instrumentation. Catalog has clear text and pictures.

**Circle 657 on Page 19**

**AUTOMATIC BATCHING**—Howe Scale Co. Howe Batch-plug is quickly and easily adjusted to accurate settings—controls up to 10 ingredients—3 scales—sealed for privacy—no dials to reset—no operator error.

**Circle 658 on Page 19**

**HOPPERAL DRIVER**—Haberstump-Harris, Inc. Can be equipped to drive small nails, drive screws, pins, rivets, roll pins, and a multitude of similar parts. Complete details on request.

**Circle 659 on Page 19**

**BEAM SCALE ATTACHMENT**—Howe Scale Co. Weighto-graph ends "scale squint." Large easy-to-read attachment for any beam scale permits easy reading of weight. Plugs into ordinary electrical outlet. Use indoors or out. Detailed booklet available.

**Circle 660 on Page 19**

**NET WEIGHING MACHINE**—Exact Weight Scale Co. Weighs and feeds dry, free-flowing materials. Accuracies of 1/10 gram. Shadowgraph scale. Bulletins 3311, 3318, and 3363 available.

**Circle 661 on Page 19**

**AUTOMATIC WEIGHING MACHINE**—Lynch Corp. Wey-Mor automatic weighing and bag filling machines provide gentle treatment to a wide variety of candies. Vibratory feeder along entire length eliminates friction and breakage of candy. New catalog now available.

**Circle 662 on Page 19**

**ELECTRONIC WEIGHING SYSTEMS**—Gilmore Industries, Inc. Electronic Scale Systems are fast and accurate, easy to operate—offer substantial savings in installation and maintenance costs. Indicate . . . record . . . control . . . solid or fluid weight in tanks, hoppers, or bins. Brochure available.

**Circle 663 on Page 19**

**ELECTRONIC WEIGHT DETECTOR**—Fairbanks-Morse & Co. True weight of any load automatically obtained and recorded without need of a weighman. Literature on request.

**Circle 664 on Page 19**

**WEIGHING BOOKLETS**—Fairbanks-Morse & Co. Seven volumes describe new economy and accuracy in weighing or batching—all electronically. Even shows how to make your present equipment electronic.

**Circle 665 on Page 19**

**BASIC WEIGHT CLASSIFIER**—Exact Weight Scale Co. Checkweigh or classify items by weight and utilize data wherever you need it. Handle items in any shape in a capacity range from 2000 milligrams to 100 lbs. Bulletin 3333 and 3347 tell the story.

**Circle 666 on Page 19**

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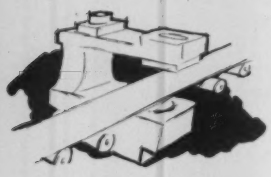

## Measuring and Gaging

**BIN LEVEL INDICATOR**—The Bin-Dicator Company. Automatic control of handling bulk material. Prevents waste, protects equipment, saves repairs. Also available is a diaphragm-type bin level indicator. Excellent on bins under pressure or vacuum. Detailed literature on request.

Circle 667 on Page 19

**CONTROL DEVICES**—Sheffield Corp. Bulletin AU57-12 gives detailed information on Sheffield's packaged controls and tooling ready to install and complete automation gaging and transfer systems ready to operate.

Circle 668 on Page 19

**AUTOMATIC GAGES**—Sheffield Corp. Each Sheffield Modulaire is a self-contained unit which may be slipped out of the assembly and replaced without interfering with other units of the assembly. Sensing units may be electronic, electrical, or mechanical as well as pneumatic.

Circle 669 on Page 19

**NUMERICAL CONTROL**—Pratt & Whitney Co. Circular No. 609 gives you all the facts on P&W Numerical Control. Automatically positions work accurate to .0001"—settings accurate to five seconds of arc—profile milling entirely under tape control.

Circle 670 on Page 19

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**HOLE RELATION GAGE**—Mayes Tool Co. Read the indicator directly, without turning either your hand or the gage handle. Knurled thumb-knob rotates the expansion spindle. Wear is greatly reduced. Indicator and dial completely protected. Con-Chek gage described completely in available literature.

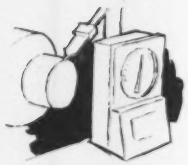
Circle 671 on Page 19

**AUTOMATIC CONTROL GAGING**—Federal Products Corp. Controls on basis of finish size only—overcomes disadvantages of timed cycle or fixed stop grinding. Improves grinding three ways. Full details on request.

Circle 672 on Page 19

**SHAFT MOTION INDICATOR**—The Bin-Dicator Company offers a new Roto-Guard shaft motion indicator. Provides positive indication of drop in speed or stopping of machinery. Operating speeds of 10 to 150 rpm. Rugged and compact. Bulletin on request.

Circle 673 on Page 19



## Testing and Inspecting

**ELECTRONIC INSPECTION SYSTEMS**—Radio Corp. of America, Industrial & Automation Div. RCA Piston Pin Inspection Machine provides selective segregation to assure proper fit in final assembly. To .0004" over-all tolerances. Panels give continuous presentation of entire operation and show actual number of parts in each classification.

Circle 674 on Page 19

## Mechanical Drives and Controls

**VARIABLE SPEED CONTROL**—Reliance Elect. & Engrg. Co., Reeves Pulley Co. Div. Reeves AIRtrol automatically and continuously corrects operating speeds to compensate for variations in materials or energy. Responds to a 3 to 15 psi pneumatic signal. Instrumentation Data Sheets on request.

Circle 675 on Page 19

**TELETYPE**—Teletype Corporation. The Teletype Model 28 Reperforator Transmitter-Distributor Set features three facilities in one unit. It combines: 1. a typing or non-typing TAPE PUNCH . . . with 2. a TAPE READER . . . plus 3. intermediate TAPE STORAGE facilities.

Circle 676 on Page 19

**WORM-GEAR SETS**—Horsburgh and Scott Company. H & S worm-gear sets insure smooth driving action between perfectly mated members. Large ratios; long service life; self-locking: Up to 60" in diameter—circular pitch range from 1/4" to 3 1/2". Ratios furnished from 3-5/9:1 to 100:1.

Circle 677 on Page 19

**SPEED VARIATOR**—Cleveland Worm and Gear Co., Speed Variator Div. Bulletin K-200 contains facts on Cleveland's

Speed Variator. Handles input speeds up to 1800 rpm—either clockwise or counterclockwise rotation.

**Circle 678 on Page 19**

**SELF-ALIGNING BEARINGS**—Southwest Products Co. Wide variety of plain types in bore sizes 3/16" to 6" dia. Rod end types in similar size range with externally or internally threaded shanks. Engineering Manual No. 551 gives the full story.

**Circle 679 on Page 19**

**BALL BEARING UNITS**—Stephens-Adamson Mfg. Co., Sealmaster Bearings Div. Sealmaster gives now a wide range of ball bearing units with mountings in shaft sizes from 1/2" to 4-15/16". Permanently sealed and pre-lubricated. Extremely quiet operation. Catalog 454 for complete details.

**Circle 680 on Page 19**

**HELICAL GEARS**—Horsburgh and Scott Company. H & S Helical Gearing with overlapping tooth action is your ideal choice for power transmissions on parallel shafts where speeds and loads are high and where smooth action is desired. Diameters up to 125", 1 D.P., and 40" face. Catalog 57 on request.

**Circle 681 on Page 19**

**VARIABLE SPEED PULLEYS**—Lovejoy Flexible Coupling Co. Hi-Lo Variable Speed Pulleys positively maintain the desired speed ratio over a wide range of load variation by means of an exclusive cam and cam follower assembly. Bulletin A-458 gives further details.

**Circle 682 on Page 19**

**PILLOW BLOCK**—Stephens-Adamson Mfg. Co., Sealmaster Bearings Div. The "LP" pillow block is a precision self-aligning one-piece unit. Malleable housing provides maximum strength with light weight. Permanently sealed. Bulletin 1058 on request.

**Circle 683 on Page 19**

**HELICAL SPEED REDUCERS**—Horsburgh & Scott Company. Catalog 55 describes H & S's Speed Reducer. Single, double, and triple reduction. Heavy-duty housings, extra bearing capacity, and oversize. Shafts guarantee ample reserve stamina for the most exacting demands.

**Circle 684 on Page 19**

**FLEXIBLE PUSH-PULL CONTROLS**—American Chain & Cable, Automotive and Aircraft Div. Acco Tru-Lay flexible push-pull controls provide positive remote-action over long or short distances. Immune to vibration. Data file available.

**Circle 685 on Page 19**

**STANDARDIZED DRIVES**—Genevamatic Engineering Corporation. Precision Genevamatic drives. 3 to 24 indexing stations. Standard center distances from 3" to 6" by 1/4" increments. Write for details and specifications.

**Circle 686 on Page 19**

**SPEED REDUCERS**—Boston Gear. No downtime for motor repairs. RATIOMOTORS come in all types and ratios. Standardized stock models are quickly available. Complete catalog on request.

**Circle 687 on Page 19**

**CONTROLLED TORQUE COUPLINGS**—Falk Corp. Bulletin 4100 tells how Falk's Controlled Torque Coupling protects against machinery damage from excessive torque or jams.

**Circle 688 on Page 19**

**SEALED BEARINGS**—McGill Mfg. Co. Camrol bearings in 1/2" to 4" roller diameters with stud or for shaft mounting save time and money when applying roller followers to cam follower, track, guide, and support roller applications. Catalog 52-A gives the complete story.

**Circle 689 on Page 19**

**CASTELLATED NUT REPLACEMENT**—Apex Machine & Tool Co. Castellated nuts were formerly removed with a hammer and chisel. Apex now provides special sockets for this application making it faster, safer, and cheaper. Catalog 29-R gives the full story.

**Circle 690 on Page 19**

**AUTOMATIC SPEED REGULATION**—Metron Instrument Co. Metron adjustable speed drives feed any variable—temperature, pressure, size, weight—into the adjustment of a Metron miniature adjustable speed drive. Bulletin 96 covers complete specs.

**Circle 691 on Page 19**

**CLUSTER SOCKETS**—Apex Machine & Tool Co. For multiple tool applications, Apex cluster socket automatically compensates for any variation in fastener height. Catalog 30-D lists several such tools.

**Circle 692 on Page 19**

**ADJUSTABLE-SPEED DRIVE**—American-Standard, American Blower Div. Gyrol Fluid Drive varies speed steplessly without costly maintenance. Units available up to 800 hp. Complete details available.

**Circle 693 on Page 19**

**POWER TRANSMISSION EQUIPMENT**—Lovejoy Flexible Coupling Co. Non-lubricated, easily-assembled flexible couplings; maintenance-free, instantly adjustable variable speed pulleys; shaft mounted, gear reducers and light-weight precision-built universal joints. Catalogs containing engineering data, on request.

**Circle 694 on Page 19**

**SCREWDRIVING BITS**—Apex Machine & Tool Co. The right screwdriving bit saves time, saves tool life, and reduces rejects. Catalog 30-C gives details on bits for Phillips, slotted, clutch head, hex head, and other type screws.

**Circle 695 on Page 19**

**WORM GEAR JACKS**—Duff-Norton Co., Coffing Hoist Div. For accurate positioning of loads weighing as much as several tons Duff-Norton Worm Gear Jacks are furnished with raises up to 24". Full specifications, including drawings, available.

**Circle 696 on Page 19**

**INDEXING DRIVE**—Ferguson Machine Corp. Easy-to-use catalog containing load ratings and dimensions explains Ferguson Drive for indexing mechanisms.

**Circle 697 on Page 19**

**NUT RUNNING TOOLS**—Apex Machine & Tool Co. 5,000 stock types and sizes of fastening tools solve your nut running work problems. Catalog 30-A covers tools up to 5/8" drive. Catalog 30-B covers 3/4" drive and larger.

Circle 698 on Page 19

**GEARS**—Boston Gear Works. Catalog 9496 describes complete line of standardized transmission products. Types and sizes to fit most transmission needs. Catalog has 664 pages, with 58 pages of improved selection charts and engineering information.

Circle 699 on Page 19

**UNIVERSAL JOINTS**—Apex Machine & Tool Co. Catalog 28 describes full range of standard universal joints, 3/8" to 4" diameter sizes. Special joints also available for unusual applications.

Circle 700 on Page 19

## Machining and Grinding

**HOLE-MACHINING**—National Automatic Tool Co. Standard multispindle NATCO's range from 1 hp, 10-spindle high-speed machines to giant heavy duties with 50 hp and up to 72 spindles. Write for complete specifications.

Circle 701 on Page 19

**TRANSFER MACHINE**—National Automatic Tool Co. Each station in a Natco transfer machine—whether drilling, boring, milling, sowing, or chamfering—is a machine tool in its own right. Full specifications and case histories on request.

Circle 702 on Page 19

**BORING MACHINES**—Snyder Corp. Snyder machines are engineered for profit opportunities. Special boring and transfer machines have been developed for many major industries. New brochure describes full range of Snyder special machines.

Circle 703 on Page 19

**AUTOMATION LINES AND EQUIPMENT**—Automation Development Corp. Designers and builders of high quality automation lines and other special equipment. Further facts on request.

Circle 704 on Page 19

**GRINDING MACHINES**—Cincinnati Milling Machine Co., Grinding Machine Div. Precision cylindrical grinding equipment of any size ranging from versatile toolroom grinders to completely automated grinding lines.

Circle 705 on Page 19

**SPEED INDEXERS**—Erickson Tool Co. Catalog K describes applications for Erickson Speed Indexers which assure positive positioning and angular accuracy within 2 minutes of a degree.

Circle 706 on Page 19

**MILLING ATTACHMENT**—Greenlee Bros. & Company. Greenlee Milling Attachment performs a variety of milling operations. Eliminates second operation milling on many jobs. Write for catalog A-405 for complete details.

Circle 707 on Page 19

**PROFILING MACHINES**—Ex-Cell-O Corp., Machinery Div. Tape controlled precision profiling machines provide 360° work rotation for three-dimensional machining of complex parts.

Circle 708 on Page 19

**CAM MILLING MACHINES**—Ex-Cell-O Corp., Machinery Div. Human error eliminated, blueprints and models done away with, lead time drastically cut on Numeri-Trol tape controlled cam milling machines.

Circle 709 on Page 19

**INDEXING TABLE**—Gray Equipment Company. Geneva Motion GEM-17 indexing table with precision indexing to ±0.001". Standardizes automation on your assembly and machining operations. Bulletin DI-17 has complete information.

Circle 710 on Page 19

**DRILLING UNIT**—Bedford Gear and Machine Products, Inc. Save up to 70% drilling time with Rotorized spindle drilling unit. Hook up either air or electricity. Provides positive even feed. Compact. Powerful. Catalog available.

Circle 711 on Page 19

**BORING BAR**—Modern Mfg. Co. Modern boring bar kills vibration and chatter in boring. Has various size holes drilled from each end to minimize harmonic vibration. Cavity is filled with shock absorbing material under vacuum.

Circle 712 on Page 19

**MODERNIZE PRESSES**—E. W. Bliss Company. Replace the old, outdated features on your presses with brand new factory-engineered assemblies. New clutches, new slide adjustments, and new bearings are only three of the 42 modernization assemblies available.

Circle 713 on Page 19

**MULTIOPERATION MACHINE TOOLS**—Buhr Machine Tool Company. Multiple operation high and low production equipment. Standardized "building-block" parts are used wherever possible in machines, fixtures, etc. This convertibility adds years of useful life to your machine tools. Further details on request.

Circle 714 on Page 19

**DRILLING MACHINE**—Crescent Tool and Machine Co. Standard gun drilling machine available in speeds of 2000 to 8000 rpm. Gun drill diameters 187 to 750. Complete details available.

Circle 715 on Page 19

**NUMERICAL CONTROL**—Jones & Lamson Machine Co. Tape controlled positioning units hold tolerances of ±.001 on applications for punching, drilling, boring, etc. Machine set-up and changeover become primarily an office procedure. Write for complete details on this numerical control technique.

**Circle 716 on Page 19**

**MILLING MACHINE**—Kearney & Trecker Corp. Bulletin MM-58 describes the Mil-waukee-Mil programmed production milling machine. Dial-a-cycle control panel eliminates guesswork. Choose from 72 models—Simplex and Duplex—7½ to 30 hp.

**Circle 717 on Page 19**

**CONTOUR CHASING LATHE**—R. K. LeBlond Machine Tool Co. Cut with confidence on LeBlond Contour Chasing Lathe. A 32" Standard-duty lathe with special end gearing, full nut, special length slide, automatic cycling, and special heavy duty reversing electric. Chases leads from 4½" to 16". Literature on request.

**Circle 718 on Page 19**

**TOOL HOLDERS**—Erickson Tool Co. Morse taper, milling machine turret lathe, and straight shank holders described in detail in Erickson's Catalog G, "Quick Change Holders."

**Circle 719 on Page 19**

**AUTOMATIC DRILLING UNIT**—Bedford Gear and Machine Products, Inc. Hudroscape automatic drilling unit offers proven 10% reduction in cycle time. You get more automatic operations per dollar. Catalog and data sheets on request.

**Circle 720 on Page 19**

**TAPE CONTROLLED TURRET DRILL**—Burg Tool Mfg. Co. Bulletin describes Burgmaster Co. and 8-Spindle Tape Controlled Turret Drilling, Tapping, and Boring Machines. G. E. numerical system controls all machine functions, selects spindles in any sequence, automatically positions the tables on two tapes, clamps the tables while machining operations are performed, and controls coolant.

**Circle 721 on Page 19**

**AUTOMATED PRODUCTION LINE**—The Heald Machine Company. When the time comes for a job changeover . . . you can do it at a saving with Heald Bore-Marics. Compared to previous methods, the new Heald system results in less handling and locating of parts, fewer rejects, greater efficiency, and substantially lower production costs. Complete information on this interesting installation on request.

**Circle 722 on Page 19**

**PRESSES**—E. W. Bliss Company. High Production presses designed for continuous high speed operation. Counterbalanced shaft, massive tie rod frame, and square gibbing. Ample operating room in front and back. More facts available.

**Circle 723 on Page 19**

**TRANSFER MACHINES**—Greenlee Bros. & Company. Greenlee Transfer Machines can be reworked to meet product changes. The "Rearrangeable Unit" concept of transfer machine design is becoming increasingly popular in mass production manufacturing. Complete details on request.

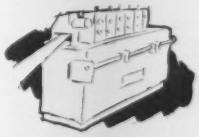
**Circle 724 on Page 19**

**DIAL FEED PRESSES**—Federal Press Co. Gear or chain driven with cam-type indexing mechanisms. Sizes from 6 to 80 tons. Virtually unlimited applications.

**Circle 725 on Page 19**

**JIG BORER**—Fosdick Machine Tool Co. Fosmatic Jig Borer Bulletin JB-P tells story of boring technology. Table automatically positions work to ±.0001".

**Circle 726 on Page 19**



## Forming and Cutting

**HYDRAULIC PRESSES**—Air-Hydraulics Inc. New, versatile 15 ton press for stand or bench installation provides simple, tireless, and safe operation. Handles all kinds of materials. Application information available.

**Circle 727 on Page 19**

**DRILLING & TAPPING MACHINES**—Baker Brothers, Inc. offer a full line of hydraulic vertical and horizontal drilling and tapping machines. Advanced design assures minimum maintenance, permits faster retooling using standard components. New catalog available on request.

**Circle 728 on Page 19**

**COLD ROLL FORMING MACHINES**—The Yoder Company. High speed, Yoder cold roll-forming machines are the most economical method for mass producing structural or ornamental shapes. One machine with one operator can form up to 40,000 feet of shapes per day. Fully descriptive booklet available.

**Circle 729 on Page 19**

**CIRCLE ITEM NUMBERS FOR FREE INFORMATION**

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**AUTOMATIC SHEARING**—McKay Machine Co. Revolutionary McKaymatic high production Die Shear line instantly responds to length and quantity command. Any width or thickness.

**Circle 730 on Page 19**

**ROUTER**—Buckeye Tools Corp. For precision cutting of the most intricate contours in metals, plastics, wood, and honeycomb materials. An entirely new kind of metal-cutting tool. Compact, lightweight. Catalog available.
Circle 731 on Page 19

**STAMPING PRESS**—Wean Equipment Corporation. Wean "Flying Press" produces stamped parts at absurdly low costs per piece. Eliminates the use of clutch, brake, and fly-wheel; all points of potential press break-down. Booklet describes entire operation.
Circle 732 on Page 19

**IMPACT HAMMER**—Air-Hydraulics Inc. Impact hammer makes 50 strokes per cubic foot of air at 100 psi line pressure. For awkward jobs, heads available separately can be mounted in any position—even upside down. Catalog describes applications.
Circle 733 on Page 19

**PRODUCTION TOOLS**—Black & Webster, Inc. Electro-punch or full automatic Electroset can solve your terminal setting problems. Set hand fed terminals twice as fast as conventional methods. All electric. Customized to your needs. 12-page catalog describes complete line.
Circle 734 on Page 19

**PIPE AND TUBE MILLS**—The Yoder Company. Pipe and Tube Mills offer flexible production to meet fluctuating demand. They adapt easily to the most rigorous schedules. Everyday manufacture of constant high quality pipe and tube in diameter of 5/16" to 24". Speeds up to 350 fpm plus. Booklet available.
Circle 735 on Page 19

**AIR INDEX TABLE**—Air-Hydraulics, Inc. Index 30 position per minute with new 24 in. diam index table. Handles work loads up to one ton. Clockwise and counterclockwise rotations available in 3 to 60 position models. Catalog available.
Circle 736 on Page 19

**ELECTRONIC LENGTH GAGE**—McKay Machine Co. McKay's electronic length gage has a memory—permitting instantaneous changes in cut lengths and scheduled quantities as well as precise control of notch and punch spacing on each length. Literature on request.
Circle 737 on Page 19

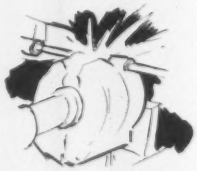
**AIR TOOLS**—Buckeye Tools Corp. Catalog G-10 describes full details on a complete line of industrial air tools. Includes drilling, fastening, abrasive, and special air tools.
Circle 738 on Page 19

**MULTIPRESS**—American Brake Shoe Co., Denison Engineering Div. Complete line of Denison Hydraulic Multipresses in 1 to 75 ton capacities covered in new catalog.
Circle 739 on Page 19

**AUTOMATIC CUT-OFF**—Modern Machine Tool Co. Illustrated catalog has complete specifications of Modern cutting-off machines and automatic loaders. Handles solid bar stock up to 3" o.d.—tubing up to 8" o. d. Cuts any material that can be turned. 16 spindle speeds.
Circle 740 on Page 19

**ROTARY SLITTERS**—The Yoder Company. Line includes slitters of every size and capacity for coil or sheet stock. Send for the all-new Yoder Slitter Book. Contains a comprehensive text on the mechanics and economics of slitter operations with time studies, cost analysis, and other valuable data.
Circle 741 on Page 19

**DRILLING HEADS**—United States Drill Head Co. Drill heads designed to drill as fast as you need . . . and still maintain accuracy. All heads have shaved gears which assure quiet, smooth operation at all speeds. Catalog FC-57 has complete data.
Circle 742 on Page 19



## Welding and Brazing

**WELDING**—Acro Welder Manufacturing Company. Established in 1936 . . . Welding Engineers and machinery builders. More information on request.
Circle 743 on Page 19

**AUTOMATIC ASSEMBLY MACHINES**—Automation Machines and Equipment Co. Automatic assembly machine for chessman. Manually load chess piece and steel weight; press weight into base; apply glue automatically; stamp felt pad and apply; pressure set felt pad and aireject.
Circle 744 on Page 19

**MOTOR LAMINATIONS ORIENTER**—Automation Machines & Equipment Co. AECO orienter for motor laminations deposits blank from conveyor belt onto rotating spindle—stacked according to key.
Circle 745 on Page 19

**RESEARCH CENTER**—Sciaky Bros. Inc. Sciaky Research Center has become a major source to all manufacturers for 1.) basic and advanced research, 2.) development of experimental tooling and fixturing, 3.) assembly of experimental and prototype models, 4.) pilot production runs, etc.
Circle 746 on Page 19

**STEEL FEEDER**—Automation Machines & Equipment Co. Automatic sheet steel feeder provides no delay between

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transfer of sheets; rolls deformed edges flat. 5′ to 20′ sheet length.

**Circle 747 on Page 19**

**SHELL WRAPPER AND WELDER**—Automation Machines and Equipment Co. Ameco's shell wrapper and welder for electric motors handles diameters from 5″ to 9″; Lengths up to 9′; thicknesses from 16 ga. to ⅛″.

**Circle 748 on Page 19**

**ELECTRIC WELDING MACHINES**—National Electric Welding Machines Co. Designers and builders of special and standard air, hydraulic, motor driven, spot, projecting, seam, butt, flash, and resistance welders and production fixtures for all types of automatic arc welding.

**Circle 749 on Page 19**

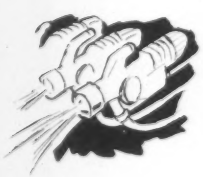
**AUTOMATIC LOADER AND UNLOADER**—Automation Machines and Equipment Co. Automatic loader and unloader for motor laminations up to 30″ diameter. Loads and unloads in less than 2 seconds. Requires no operator except for reloading.

**Circle 750 on Page 19**

## Heat Treating Equipment

**HEAT TREATING EQUIPMENT**—C. I. Hayes, Inc. Solve your heat treating problems the Results Guaranteed way. Bulletins on request which describe fully the famous C. I. Hayes Certain Curtain electric furnace line. Write today.

**Circle 751 on Page 19**



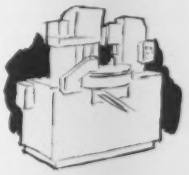
## Painting and Finishing

**ELECTROSTATIC HAND GUN**—Ransburg Electro-Coating Corp. No. 2 Process Electrostatic Hand Gun saves paint because there's no waste. Saves in equipment because no conventional spray booth is required. Paints all sides from one side only. Literature available.

**Circle 752 on Page 19**

**AUTOMATIC SPRAY**—DeVilbiss Co. Automatic spray machines consistently turn out paint jobs to perfection on products of practically any size and shape. Information on request.

**Circle 753 on Page 19**



## Automatic Assembly Equipment

**INDEXING UNIT**—Standard Tool & Mfg. Co. Medium and heavy duty cam type and conveyor or transfer type indexing units—the heart of automatic machines. Accuracy ±.003″. Production rate 1000 to 6000 per hour. Technical booklets on request.

**Circle 754 on Page 19**

**AUTOMATIC RIVET-SETTING MACHINE**—Judson L. Thomson Mfg. Company. Automatic-Feed Rivet-Setting Machines that can help you improve product quality and reduce costs. Catalog has complete details.

**Circle 755 on Page 19**

**PRODUCTION AUTOMATED RIVETING**—Tubular Rivet & Stud Company. PAR the TRS process that employs standard and multi-head machines to make riveting practically a new fastening method. Automation of assembly operations becomes a reality through efficiently integrated and automatic feeding, transfer, sequencing, control, sensing, and ejection. Full details and specifications on request.

**Circle 756 on Page 19**

**ROTARY HOPPER**—Radio Corp. of America, Industrial & Automation Div. RCA Automatic Rotary Hoppers provide every needed operating feature, yet are offered at remarkably low prices. Up to 20,000 parts per hr. 18″, 24″, and 30″ bowls available.

**Circle 757 on Page 19**

**QUALITY MACHINE WORK**—American Can Co. operates four machine shops staffed with experienced engineers, designers, and machinists who can design and manufacture any high-speed machinery, dies, fixtures, tools, and parts your business might need.

**Circle 758 on Page 19**

**CONVEYMATIC TRANSFER TABLES**—Visi-Trol Engineering Company. Conveymatic transfer tables are low in cost, but built to machine tool precision . . . are ideal for manual assembly operations that require fixturing for accuracy and quality control. Complete tooling service, design and/or build. Data available.

**Circle 759 on Page 19**

**AUTOMATIC ASSEMBLY EQUIPMENT**—Dixon Automatic Tool, Inc. Fast assembly of parts with two types of equipment: Auto-Positioners for automatic assembly work and auto-torque drivers for automatic placing and driving of screws and nuts. Descriptive bulletins on request.

**Circle 760 on Page 19**

**AUTOMATIC ASSEMBLY**—Sperry Products, Inc. Multra engineers are qualified to take over completely the design and assembly problems related to automatic assembly of a product and to deliver a machine ready to operate in full production. Technical brochure available.

Circle 761 on Page 19

**AUTOMATED PRODUCTION UNITS**—Automation Development Corp. ADC multi-stage automatic machine saws parts from the bar combining primary and secondary operations such as stamping, drilling, tapping, etc.

Circle 762 on Page 19

**AUTOMATED ASSEMBLY EQUIPMENT**—Gray Equipment Company. Design, manufacture, installation, and initial operation of automated assembly equipment. Complete engineering staff to save you money and answer your questions. For further information write.

Circle 763 on Page 19

**INDEXING MACHINE CHASSIS**—Swanson-Erie Corp. A Swanson Standard Indexing Machine Chassis saves both time and money—gives you a head start on special purpose automatic machines for processing, machining, and assembly operations. Illustrated folder on request.

Circle 764 on Page 19

**HYDRAULIC REMOTE CONTROLS**—Sperry Products, Inc. Sperry hydraulic controls—circular motion; straight line motion; multiple control; geared take-off—manual or automatic. The only single tube balanced system.

Circle 765 on Page 19

**AUTOMATION AIR TOOLS**—Aro Equipment Corp. solves your problems in drilling, tapping, or fastening. Bulletin 5546-T describes single or multiple set-ups. Choice of 4 sizes.

Circle 766 on Page 19

**INDEXING UNIT**—Benerson Corporation. AUTOMOTOR is a pre-engineered indexing unit which is adaptable to your specific requirements. Specially engineered for the feeding, orienting, placing, and ejecting assemblies. Full details on request.

Circle 767 on Page 19

**TRANSFER MECHANISMS**—Sheffield Corp. Sheffield Press-Pacers are all readily demountable transfer mechanisms used to automate one or a line of straight-side presses. One press can be made to do the work of several. Catalog PP3M-57 tells the complete story.

Circle 768 on Page 19

**CIRCLE ITEM NUMBERS FOR FREE INFORMATION**

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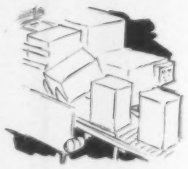
**INDUSTRIAL FILTRATION**—American Laundry Machinery Co., Olson Filtration Engineers Div. Filter available in eight standard models, from 10 gpm to 600 gpm capacities. Every cycle—precoat, run, backwash—is automatically controlled. Guarantee 96% purification of all types of coolants, cutting oils, and washing solvents. Catalog on request.

Circle 769 on Page 19

**STATOR WINDER**—Fort Wayne Tool, Die & Mfg. Co. Automatic simultaneous winding of two or three group concentric coils. 325 turns per minute winding speed. Complete data on request.

Circle 770 on Page 19



## Packaging

**PACKAGING**—Gaylord Container Corporation. Gaylord offers to survey your total packaging operation. If you demand increased production, improved protection, and important savings in corrugated packaging, you'll want to contact Gaylord for full information.

Circle 771 on Page 19

**PRESSURE-SENSITIVE LABELS**—Avery Label Co. Your product tells its own story with Avery Golden perma-grip pressure sensitive labels. Corners won't curl or peel. Can be applied to a variety of surfaces. Catalog and free samples available.

Circle 772 on Page 19

**AUTOMATED PACKAGING**—J. L. Ferguson Co. Packomatic equipment feeds, forms, positions, loads, seals, and imprints corrugated shipping containers automatically. Additional details available.

Circle 773 on Page 19

**CORRUGATED BOXES**—West Virginia Pulp and Paper Co., Hinde and Dauch Div. New M/R corrugated boxes stay strong when wet—even under water. M/R boxes stack high and straight. Smooth, clean surfaces can be colorfully printed with your brand message. Samples and complete information on request.

Circle 774 on Page 19

**AUTOMATIC PACKAGING MACHINE**—Lynch Corp. Robo-Wrap forms, fills, and seals pillow packages. Can run at 120 bags a minute. Packages in cellophane, paper, poly, plastic, or laminates. Increases efficiency and economy and minimizes work stoppages. New illustrated folder gives full story with case histories.

Circle 775 on Page 19

**LABEL DISPENSERS**—Avery Label Co.—Manual or automatic dispensers in a variety of models and sizes help you obtain fast, clean, and economical labeling. Catalog gives complete story.

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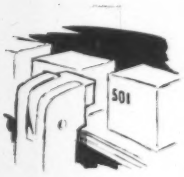
**PRECISION PACKAGING**—West Virginia Pulp and Paper Co., Hinde and Dauch Div. Would precision packaging speed up your operations? H & D, authority on packaging has helped such firms as Standard Oil of Ohio and Hotpoint Co. with difficult packaging problems. Complete details and samples on request.

**Circle 777 on Page 19**




## Printing and Marking

**ROLL DIES**—New Method Steel Stamps, Inc. New Method's custom-made roll dies can be used on any secondary marking machine or special device. Mark on any surface shape. New catalog MA-59 gives the complete story.

**Circle 778 on Page 19**

**IMPACT PRESSES**—Heidrich-Nourse Company. Pneumatic Impact Presses for impression, marking, staking, and riveting. Pressures may be adjusted for impact force from 100 lb to 20,000 lb. Fast . . . accurate . . . safe . . . easy to set up and maintain. Literature available.

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**ROLL MARKERS**—New Method Steel Stamps, Inc. Specially built for all types of radial end-face marking. Adjustable marking depths. Eliminates secondary end-face marking operations. Contains an automatic resetting device. Brochure 900-AC.

**Circle 780 on Page 19**

**BLAST ETCHING**—Jas. H. Matthews & Co. You name it, Matthews Airgrit will mark it. A short blast is all that's needed to produce a permanent "etched" mark on delicate parts or hard to mark surfaces such as glass, plastic, steel, or anodized aluminum. Bulletins C-25 and C-26 give story.

**Circle 781 on Page 19**

**PRE-PRINT CONTAINERS**—Industrial Marking Equipment Co. New Autoprinter dates, marks, or codes multiwalled bags and containers as you need them. Up to 3000 impressions per hour. Catalog on request.

**Circle 782 on Page 19**

**OFFSET PRINTERS**—Jas. H. Matthews & Co. Matthews offset printers installed as part of your production line permits speed and economy of marking products as they are produced. Available in fully motorized or friction driven units.

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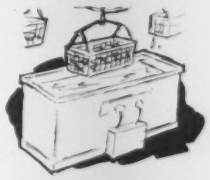

## Cleaning and Washing

**SOLVENT DEGREASING**—Detrex Chemical Industries, Inc. Save 15% and more on trichlorethylene. Request booklet on "Solvent Degreasing—What Every User Should Know."

**Circle 784 on Page 19**

**ULTRASONIC CLEANING**—Detrex Chemical Industries Inc. Informative paper describes ultrasonic cleaning techniques for precision parts. Gets parts cleaner than by any other method.

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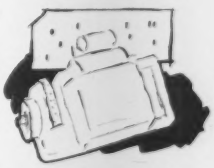
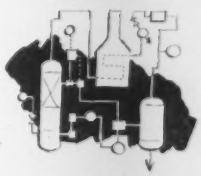


## Data Processing

**DATA RECORDING**—Monroe Calculating Machine Co. Monroe "Data/Log" is a parallel entry printer with automatically positioned carriage. Formats for printed copy. From 3 to 14 digits for each print cycle. Complete literature on request.

**Circle 786 on Page 19**



## Special Lines and Plants

**CUSTOM MACHINE**—Ex-Cell-O Corp., Machinery Div. From rough heavy boring and plug-facing to finish precision boring and facing in one machining cycle.

**Circle 787 on Page 19**

**AUTOMATIC TOOL CHANGER**—Kearney & Trecker Corp., Milwaukee-Matic—a flexible automated machining center that unifies milling, drilling, reaming, tapping, and bor-

ing operations in a single machine, harnessing the full potential of numerical control. Bulletin available with complete details.

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**TRANSFER LINE**—Cincinnati Milling Machine Co., Special Machine Div. 26 Station Unit Type transfer machine performs 33 machining operations for Ford. Machine cycles 137 times per hour. This same know-how could help you.

Circle 789 on Page 19

**NUMERICAL CONTROL**—Cincinnati Milling Machine Co., Cincinnati Numerically Controlled (CNC) Machine Tools give positive cost control at the machine. Publication M-2066 gives complete details.

Circle 790 on Page 19

**COOPERATION FOR AUTOMATIC PRODUCTION**—Greenlee Bros. & Company. The emphasis is on cooperation at Greenlee. Machines designed with the future in mind. Includes: Multiple-Spindle Drilling and Tapping Machines; Transfer-Type Processing Machines; Six and Four Spindle Automatic Bar Machines; Hydro-Borer Precision Boring Machines; Core Box Rollover and Draw Machines; Die Casting Machines. Full details on request.

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**AUTOMATIC BAR MACHINES**—Greenlee Bros. & Company. Catalog A-405 is the first step on the way to more profitable production. Complete data on all Greenlee machines and tools. Write today.

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**MULTI-STATION TRANSFER MACHINES**—Moline Tool Co. "Hole-Hog" machine for such jobs as multi-spindle boring; single and multispindle honing; straight line multi-drilling; adjustable spindle drilling; vertical and way-type fixed center drilling, boring, and tapping.

Circle 793 on Page 19

## Miscellaneous

**LEVELING JACK**—Enterprise Machine Parts Corp. Solid foundations for all types of production equipment. Supports up to 10 tons each. Six styles, 25 models available. Bulletin 100 describes the entire Empco line.

Circle 794 on Page 19

**CONTROLS CABINETS**—Elgin Metalformers Corp. Catalog 106 reviews the full line of Emcor pre-engineered cabinets that give erector-set versatility to industrial needs.

Circle 795 on Page 19

**STAMPINGS**—Lansing Stamping Co. Stampings produced economically for automotive, industrial equipment, domestic appliances, agricultural industries, and others will boost your output at material savings.

Circle 796 on Page 19

**STORAGE SHELVING**—Equipto. 16 page booklet, "Short Cuts to Greater Profits Through Lower Overhead," describes Equipto shelving with dividers, bin fronts, protective panels and jam-proof drawers.

Circle 797 on Page 19

**AUTOMATED CHARTING**—Labelon Tape Co. Graph-A-Plan—a new concept of methods and materials for chart and layout preparation. Includes a variety of pressure-sensitive solid color or pattern tapes, flow symbols, pie charts, scales, etc., plus opaque and transparent plastic planning boards. Available separately or in kits. Catalog describes entire process.

Circle 798 on Page 19

**PRECISION MEASURING TOOLS**—George Scheer Co., Inc. Company offers a 96 page cataloge (#25) of precision measuring tools and instruments.

Circle 799 on Page 19

**STAMPINGS BULLETIN**—WLS Stamping Company. For those manufacturers who are faced with manufacturing problems, a fully illustrated bulletin shows all the many stampings WLS has produced, as well as a sample and cost summary of an actual part. Free quotations from your blueprints too. Write now for full details.

Circle 800 on Page 19

**FORGING AHEAD IN BUSINESS BOOKLET**—Alexander Hamilton Institute. For the engineer who refuses to stagnate. A complete 48-page booklet written for mature, ambitious men who seriously want to get ahead in their profession. Write today.

Circle 801 on Page 19

**STANDARDS CATALOG**—Jergens Tool Specialty Co. 84-page catalog of complete specifications and cost saving data on over 2000 "Standards," including world's largest line of workholding equipment.

Circle 802 on Page 19

**STORAGE DRAWERS**—Equipto. Drawer units have adjustable dividers which lock in place. Top of drawers are slanted back with instantly visible label holders. Ask for drawer manual #206.

Circle 803 on Page 19

**CIRCLE ITEM NUMBERS FOR FREE INFORMATION**

For more information on any product or useful material mentioned throughout the Review, simply circle the Item Number on the Inquiry Card on Page 19. It will be sent to you free of charge in a very short time.

**TRUCKS**—Thomas Truck & Caster Company. Trucks that are "job-suited" to your products and equipment. Trucks for fast, safe, economical materials handling—carry loads up to 50 tons—have all the latest power equipment. Complete catalog available.

**Circle 804 on Page 19**

**OPTICAL DIVIDING HEAD**—George Scheer Co. Inc. Carl Zeiss-Jena optical dividing head does not depend for accuracy on worm, worm gears, or index plates. Indexing by a divided glass circle or vernier. Accuracy ± 5 seconds. 0-6 360 degree range of scale.

**Circle 805 on Page 19**

**HANDBOOK OF AUTOMATION, COMPUTATION, AND CONTROL**—John Wiley & Sons, Inc. Here's one complete handbook which provides all levels of technical personnel—including management—with up-to-date information about automation, computation, and control. Over 1000 pages. Write for more details.

**Circle 806 on Page 19**

**DATA PROCESSING CONSULTANTS**—Lawrence B. Taylor, Inc. Data Processing Consultants, Analysts, Systems Architects available to clients around the world. Consultation, analysis, specification, installation, and evaluation. Brochure on request.

**Circle 807 on Page 19**

**RESEARCH SERVICE**—Lindly & Co. Research and development is the only shortcut to faster, better, more economical production. More than a score of Lindly developed devices and systems have been developed for industrial and military applications.

**Circle 808 on Page 19**

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